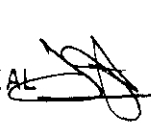


THE CONTENTS OF THIS DOCUMENT ARE  
THE HIGHEST QUALITY AVAILABLE.

INITIAL



DATE

10/7/94



**INEL**  
Idaho National Engineering Laboratory

**Environmental  
Restoration**

Revision 2  
May 8, 1993

**Track 2**

**Summary Report**

**for**

**Operable Unit 3-07**

**(Tank Farm Area I)**

DOES NOT CONTAIN  
UNCLASSIFIED CONTROLLED  
NUCLEAR INFORMATION

Reviewing  
Official:

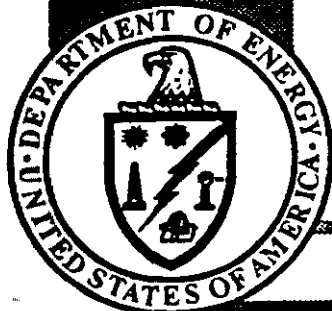
*Don R. Alexander*  
*Staff Engineer*  
Name/Title ✓

Date:

*5-7-93*



**Westinghouse Idaho  
Nuclear Company, Inc.**



**Idaho National Engineering Laboratory**

**U.S. Department of Energy, Idaho Field Office**

## TABLE OF CONTENTS

1.0	Introduction . . . . .	1-1
1.1	Purpose of the Track 2 Investigation . . . . .	1-2
1.2	Operable Unit Background . . . . .	1-2
1.2.1	Operable Unit History . . . . .	1-2
1.2.2	Operable Unit Description . . . . .	1-2
1.3	Report Organization . . . . .	1-11
2.0	Operable Unit Investigation . . . . .	2-1
2.1	Scoping Process - No Further Field Investigation Sites . . . . .	2-1
2.1.1	CPP-16 . . . . .	2-1
2.1.2	CPP-20 . . . . .	2-3
2.1.3	CPP-24 . . . . .	2-4
2.1.4	CPP-25 . . . . .	2-4
2.1.5	CPP-30 . . . . .	2-4
2.1.6	CPP-32W . . . . .	2-5
2.2	Summary of Field Sampling Plan Objectives . . . . .	2-5
2.3	Summary of Field Sampling . . . . .	2-14
2.3.1	Laboratory Analyses . . . . .	2-14
2.3.2	Soil Sample Collection and Handling . . . . .	2-18
2.3.3	Ground Water Sampling . . . . .	2-22
2.4	Quality Assurance/Quality Control . . . . .	2-24
2.4.1	Changes to the Sampling and Analysis Plan . . . . .	2-25
2.4.2	Documentation Review of the Field Sampling . . . . .	2-25
2.4.3	Summary of Soil Analyses Validation . . . . .	2-26
2.4.4	Overall Assessment of Data Quality for Soil Samples . . . . .	2-35
2.4.5	Changes to the Ground Water Sampling and Analysis Plan . . . . .	2-35
2.4.6	Review of Field Documentation for Water Sampling . . . . .	2-36
2.4.7	Summary of Method Validation of Ground Water Samples . . . . .	2-36
3.0	Summary of the Risk Assessment Methodology . . . . .	3-1
3.1	Contaminants/Parameters of Potential Concern . . . . .	3-1
3.1.1	Contaminant Screening against Background . . . . .	3-2
3.1.2	Contaminant Screening by Pathway . . . . .	3-7

## TABLE OF CONTENTS (con't.)

3.2	Toxicity Assessment . . . . .	3-8
3.2.1	Noncarcinogenic Effects . . . . .	3-8
3.2.2	Carcinogenic Effects . . . . .	3-11
3.3	Exposure Assessment . . . . .	3-12
3.3.1	Basic Equations used for Exposure Calculations . . . . .	3-12
3.3.2	Exposure Scenarios . . . . .	3-18
3.3.3	Exposure Pathways and Release Mechanisms . . . . .	3-19
3.3.4	Uncertainty Evaluation . . . . .	3-21
4.0	Results of the Track 2 Investigation and Risk Assessment . . . . .	4-1
4.1	CPP-26 (Contaminated Soil from Steam Flushing Operation) . . . . .	4-1
4.1.1	Nature and Extent of Contamination . . . . .	4-4
4.1.2	Quantification of Exposure . . . . .	4-10
4.1.3	Risk Characterization Summary . . . . .	4-13
4.1.4	Uncertainty Discussion . . . . .	4-13
4.1.5	Human Health Assessment . . . . .	4-16
4.2	CPP-28 (Contaminated Soil South of WM-181 by Valve Box A-6) . . . . .	4-16
4.2.1	Nature and Extent of Contamination . . . . .	4-20
4.2.2	Quantification of Exposure . . . . .	4-23
4.2.3	Risk Characterization Summary . . . . .	4-23
4.2.4	Uncertainty Discussion . . . . .	4-28
4.2.5	Human Health Assessment . . . . .	4-30
4.3	CPP-31 (Contaminated Soil South of Tank WM-183) . . . . .	4-30
4.3.1	Nature and Extent of Contamination . . . . .	4-30
4.3.2	Quantification of Exposure . . . . .	4-40
4.3.3	Risk Characterization Summary . . . . .	4-40
4.3.4	Uncertainty Discussion . . . . .	4-43
4.3.5	Human Health Assessment . . . . .	4-43
4.4	CPP-32E (Contaminated Soil Adjacent to Valve Box B-4) . . . . .	4-45
4.4.1	Nature and Extent of Contamination . . . . .	4-45
4.4.2	Quantification of Exposure . . . . .	4-47
4.4.3	Risk Characterization Summary . . . . .	4-49
4.4.4	Uncertainty Discussion . . . . .	4-49
4.4.5	Human Health Assessment . . . . .	4-49
4.5	CPP-79 (Tank Farm Release Near Valve Box) . . . . .	4-52
4.5.1	Nature and Extent of Contamination . . . . .	4-52
4.5.2	Quantification of Exposure . . . . .	4-57
4.5.3	Risk Characterization Summary . . . . .	4-57
4.5.4	Uncertainty Discussion . . . . .	4-57
4.5.5	Human Health Assessment . . . . .	4-57

## TABLE OF CONTENTS (con't.)

5.0	Perched Ground Water near the Tank Farm . . . . .	5-1
5.1	Water Level Measurements . . . . .	5-1
5.2	Perched and Vadose Zone Ground Water Quality . . . . .	5-5
5.2.1	Perched Ground Water Quality . . . . .	5-5
5.2.2	Lysimeter Water Quality . . . . .	5-10
5.3	Conclusions . . . . .	5-13
6.0	Summary and Recommendations . . . . .	6-1
7.0	References . . . . .	7-1
Appendix A	Track 1 Decision Documents for Sites CPP-16, CPP-20, CPP-24, CPP-25, CPP-30, and CPP-32	
Appendix B	Borehole Logs	
Appendix C	Scoping Process to Determine Potential Contaminants of Concern	
Appendix D	Parameters and Health Effects for Site Contaminants	
Appendix E	Analytical Results from the Perched Water Sampling	
Appendix F	Model Results from GWSCREEN	

## LIST OF FIGURES

Figure 1-1	Map of the INEL showing the location of the ICPP . . . . .	1-3
Figure 1-2	Operable Unit 3-07 and site CPP-55-06 within the ICPP . . . . .	1-4
Figure 1-3	Release Sites within OU 3-07 . . . . .	1-5
Figure 2-1	Location of the Boreholes at site CPP-26 . . . . .	2-11
Figure 2-2	Location of the Boreholes at site CPP-32E . . . . .	2-12
Figure 2-3	Location of the Borehole at site CPP-79 . . . . .	2-13
Figure 4-1	Location of the Excavated Areas Within Site CPP-26 . . . . .	4-3
Figure 4-2	Location of the Boreholes at CPP-26 and the Subsurface Beta-Gamma Radiation Measurements . . . . .	4-5
Figure 4-3	1990-1991 Surface Radioactivity Clean up Status . . . . .	4-11
Figure 4-4	Location of the "Observation Wells", Boreholes and Excavations Associated with Site CPP-28 Following the Release . . . . .	4-18
Figure 4-5	Location of the Geophysical Surveys and Excavation Performed During the Track 2 Investigation . . . . .	4-21
Figure 4-6	Locations of the "Observations Wells" at Site CPP-31 . . . . .	4-31
Figure 4-7	1975 Isopleths of the Contaminated Soil at Site CPP-31 . . . . .	4-35
Figure 4-8	Subsurface Radiation Profiles for Site CPP-79 . . . . .	4-55
Figure 5-1	Locations of the Perched Water Wells and Lysimeters Near the Tank Farm . . . . .	5-2
Figure 5-2	Water Level Elevations vs Time for the Perched Water Wells Near the Tank Farm . . . . .	5-4
Figure 5-3	Sr-90 Concentrations in the Perched Water Wells Near the Tank Farm . . . . .	5-11

## LIST OF TABLES

Table 1-1	Description of the Release Sites within OU 3-07 . . . . .	1-6
Table 2-1	Summary of the Rationale for the No Further Field Investigation (NFFI) Determination . . . . .	2-2
Table 2-2	Summary of Data Quality Objectives for the Track 2 Investigation at OU 3-07 . . . . .	2-6
Table 2-3	Sample and Analysis Plan Table for OU 3-07 . . . . .	2-15
Table 2-4	Volatile Organic and Inorganic Compounds and the Associated Method Detection Limits (MDL) for Soil Samples . . . . .	2-17
Table 2-5	Radionuclides and the Method Detection Limits . . . . .	2-19
Table 2-6	Ground Water Samples Collected from the Tank Farm Wells and Lysimeters . . . . .	2-23
Table 2-7	Compounds Detected in Sample Blanks Associated with Soil Samples . . . . .	2-28
Table 2-8	PARCC Goals for OU 3-07 from the Final Method Selection Worksheets . . . . .	2-30
Table 2-9	Relative Percent Difference (RPD) for the Soil Samples . . . . .	2-31
Table 2-10	Results of Sample Completeness for OU 3-07 . . . . .	2-33
Table 2-11	Ground Water Samples Collected During the Field Investigation . . . . .	2-39
Table 2-12	Compounds Detected in Field Blank(3GW02701) . . . . .	2-41
Table 2-13	PARCC Goals for Ground Water Samples for OU 3-07 from the Final Method Selection Worksheets . . . . .	2-42
Table 2-14	Compounds Detected in Samples 3GW01101 and 3GW02601 . . . . .	2-43
Table 3-1	Background Concentrations and Physical Properties for Possible Contaminants . . . . .	3-3
Table 3-2	Calculated Risk from HLLW for Rc-99, I-129, Np-237, and Cs-137 . . . . .	3-5
Table 3-3	Contaminant Carcinogenicity or Toxicity Measures and Uncertainty Factors . . . . .	3-9
Table 3-4	Risk Assessment Parameters . . . . .	3-13
Table 3-5	Abbreviated Equations for Intake and Risk-Based Concentrations . . . . .	3-16
Table 3-6	Input Parameter for GWSCREEN Modeling . . . . .	3-22
Table 4-1	Results of the Soil Analyses at CPP-26 . . . . .	4-6
Table 4-2	Summary of the Radionuclide Analyses for Site CPP-26 . . . . .	4-9
Table 4-3	Lifetime Intake and Exposure Table for CPP-26 . . . . .	4-12
Table 4-4	Risk Assessment Summary Table for CPP-26 . . . . .	4-14
Table 4-5	Uncertainty Assessment for Site CPP-26 . . . . .	4-15
Table 4-6	Gross Radiation Measurements of the Subsurface at Site CPP-28 Following the Discovery of the Release . . . . .	4-19
Table 4-7	Estimated Soil Contamination at CPP-28 . . . . .	4-22
Table 4-8	Lifetime Intake and Exposure Table for CPP-28 . . . . .	4-24
Table 4-9	Risk Assessment Summary Table for CPP-28 . . . . .	4-26
Table 4-10	Uncertainty Assessment for Site CPP-28 . . . . .	4-29

## LIST OF TABLES (con't)

Table 4-11	Direct Radiation Measurements in 1975 from the "Observation Wells" Installed at Site CPP-31 following the Release . . . . .	4-33
Table 4-12	Results of the 1975 Radiological Analyses of the Soil and the Calculated 1992 Concentrations based on Radioactive Decay . . . . .	4-36
Table 4-13	Summary of the Subsurface Radiation Profile Performed at Site CPP-31 on August 18, 1992 . . . . .	4-38
Table 4-14	Lifetime and Exposure Table for CPP-31 . . . . .	4-41
Table 4-15	Risk Assessment Summary Table for CPP-31 . . . . .	4-42
Table 4-16	Uncertainty Assessment for Site CPP-31 . . . . .	4-44
Table 4-17	Results from the Soil Samples Analyzed at Site CPP-32E . . . . .	4-46
Table 4-18	Lifetime Intake and Exposure Table for CPP-32E . . . . .	4-48
Table 4-19	Risk Assessment Summary Table for CPP-32E . . . . .	4-50
Table 4-20	Uncertainty Assessment for Site CPP-32E . . . . .	4-51
Table 4-21	Results of the Soil Analyses from Site CPP-79 . . . . .	4-54
Table 5-1	1992 Water Level Measurements from the Tank Farm Perched Water Wells . . . . .	5-3
Table 5-2a	Summary of Chemical Analysis from Tank Farm Wells and Well 55-06 (April 1991) . . . . .	5-6
Table 5-2b	Summary of Radionuclide Analysis from Tank Farm Wells and Well 55-06 (April 1991) . . . . .	5-7
Table 5-3	Compounds Detected in the Perched Ground Water Near the Tank Farm During the First, Second and Third Quarterly Sampling in 1992 . . . . .	5-8
Table 5-4	Results from Lysimeter Sampling During the Third Quarter in 1992 . . . . .	5-12
Table 6-1	Summary and Recommendations for the Release Sites in OU 3-07 . . . . .	6-2



## ABBREVIATIONS AND ACRONYMS

bIs	below land surface
%C	Percent Completeness
CAM	Constant Air Monitor
CAS	Chemical Abstract Series
CFA	Central Facilities Area
CLP	Contract Laboratory Program
COC	Chain of Custody
COCA	Consent Order/Compliance Agreement
cpm	Counts per minute
CPP	Chemical Processing Plant
CSWP	Construction Safe Work Permit
CY	Calendar Year
DOE/ID	Department of Energy/Idaho Operations Office
DQO	Data Quality Objective
EM	Electromagnetic
EPA	Environmental Protection Agency
ERP	Environmental Restoration Program
FFA/CO	Federal Facilities Agreement/Consent Order
FPFU	Fuel Processing Facility Upgrade
FSP	Field Sampling Plan
ft	feet
ft <sup>2</sup>	square feet
gal	gallon
GPR	Ground Penetrating Radar
HEAST	Health Effects Assessment Summary Tables
HLLW	High-Level Liquid Waste
HLLWTF	High Level Liquid Waste Tank Farm
HPT	Health Physics Technician
HQ	Hazard Quotient
ICPP	Idaho Chemical Processing Plant
ID	Inside Diameter
IDHW	Idaho Department of Health and Welfare
INEL	Idaho National Engineering Laboratory
IRIS	Integrated Risk Information System
kg	kilogram
L&V	Limitation and Validation
LDU	Land Disposal Unit
LOAEL	Lowest Observed Adverse Effect Level
MCL	Maximum Contaminant Level
mg/kg-day	milligram per kilogram-day
mR/hr	millirem per hour (also mrem/hr)
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NOAEL	No Observed Adverse Effect Level
NFFI	No Further Field Investigation
NRC	Nuclear Regulatory Commission
NWCF	New Waste Calcining Facility

## ABBREVIATIONS AND ACRONYMS (con't)

OU	Operable Unit
pCi/g	picocuries per gram
pCi/l	picocuries per liter
PEW	Process Equipment Waste
PPE	Personal Protective Equipment
QAPJP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
OD	Outside Diameter
%R	Percent Recovery
R/hr	Rem per hour
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentrations
RfD	Reference Doses
RI/FS	Remedial Investigation/Feasibility Study
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
RWMC	Radioactive Waste Management Complex
SAP	Sampling and Analysis Plan
SDG	Sample Delivery Group
SF	Slope Factor
SMO	Sample Management Office
SOOR	Significant Operating Occurrence Report
TAL	Target Analyte List
TCLP	Toxicity Characteristics Leaching Procedure
TLD	Thermo-Luminescent Detector
TOC	Total Organic Carbon
TOX	Total Organic Halogen
UF	Uncertainty Factor
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTL	Upper Tolerance Limit
VOC	Volatile Organic Compound
WAG	Waste Area Group
WCF	Waste Calcining Facility
WINCO	Westinghouse Idaho Nuclear Company
yd <sup>3</sup>	cubic yards
μg/kg	micrograms per kilogram
μCi/g	microcuries per gram

## 1. INTRODUCTION

This Summary Report describes the results from the calendar year (CY) 1992 Track 2 investigation at the Idaho Chemical Processing Plant (ICPP) Tank Farm Operable Unit (OU) 3-07. It provides a complete description of the field activities associated with the Track 2 investigation, presents the validated analytical data, and evaluates the risk posed to human health from each site. The preparation of this report, including the risk assessment methodology, and default parameters, follows the guidance provided in *Track 2 Sites: Guidance for Assessing Low Probability Hazard Sites at the INEL* (DOE/ID-10389, Rev. 3).

This report also includes the documentation of decisions made during the scoping process. The investigation for OU 3-07 was initiated as the Track 2 guidance was being prepared. As such, the original guidance recommended the use of Track 1 Decision Documentation Documents to compile existing information and identify data gaps. During the preparation of these documents, six sites were identified as requiring no further field investigation. The basis for these recommendations are summarized within the text of this report, and the actual Track 1 Documents are included as appendices. The background information for all the sites was transmitted to the EPA and the Idaho Department of Health and Welfare (IDHW) on January 10, 1992 (ref: J. Lyle [DOE-ID] to W. Pierre [EPA-Region X] and D. Nygard [IDHW]).

Six sites within OU 3-07 were recommended for further investigation. The scope of this investigation is described in the Sampling and Analysis Plan (SAP) consisting of the draft *Field Sampling Plan* (WINCO 1992a) dated February 28, 1992 and the *Quality Assurance Project Plan (QAPjP)* (WINCO 1992b) dated July 21, 1992. Comments were received from the EPA and the IDHW on April 2, 1992 and April 3, 1992, respectively. These comments were addressed in a memo dated April 24, 1992 (ref: J. Lyle [DOE-ID] to W. Pierre [EPA-Region X] and D. Nygard [IDHW]). The final modification to these plans is described in a Closure Addendum dated July 21, 1992, which also provides the final Method Selection Worksheets and Data Quality Objectives (DQO) Summary Worksheets. A complete description of the chronology for the OU 3-07 SAP development, including the final Closure Addendum, is provided in a July 31, 1992 letter (ref: J. Lyle [DOE-ID] to W. Pierre [EPA-Region X] and D. Nygard [IDHW]).

To ensure compliance with the requirements of the FSP and QAPjP, a *Field Implementation Document* (WINCO 1992c) was prepared that describes the technical and quality assurance/quality control (QA/QC) information needed to meet the project's DQOs. In general, this document was prepared by using the procedures directly from the SAP, modifying them to apply to both OU 3-07 and OU 3-08, and adding tables describing the site specific requirements. This document was utilized throughout the field portion of the investigation and includes tabulated DQOs, the Sampling and Analysis Plan Table, location maps, Field Guidance Forms, and a description of the standard operating procedures for data acquisition, decontamination, logkeeping, etc.

Field activities associated with this Track 2 investigation began in August 1992 and were completed before the end of September 1992. These activities included the collection of soil samples for chemical and radiological analyses at sites CPP-26, CPP-32E, and CPP-79; subsurface radiation measurements from the existing probes at site CPP-31; and subsurface excavation in an attempt to locate the buried probes at site CPP-28; and the collection of ground water samples from well 55-06.

## **1.1 Purpose of the Track 2 Investigation**

The preliminary scoping Track 2 investigation, according to the Federal Facilities Agreement/Consent Order (FFA/CO) and associated Action Plan, is appropriate for OUs that require additional field data collection before a decision can be made for no further action, interim action, or inclusion in a remedial investigation/feasibility study (RI/FS). According to DOE/ID-10389 (Rev. 3), sites are generally selected for a Track 2 investigation when insufficient data are available to make a decision concerning the level of risk posed by the site to human health and the environment or to assist in the selection or design of a remedy. Upon completion of the investigation, a Summary Report is prepared that evaluates the data to determine whether the OU needs no further action, some interim action, or a RI/FS scoping.

## **1.2 Operable Unit Background**

To facilitate environmental cleanup, the Idaho National Engineering Laboratory (INEL) has been divided into ten Waste Areas Groups (WAGs) as described in the FFA/CO. The ICPP, operated by Westinghouse Idaho Nuclear Company (WINCO), has been designated as WAG 3. The location of the ICPP in relation to the INEL is shown in Figure 1-1. Within WAG 3, 13 individual OUs have been identified on the basis of similar waste stream and projected remedial actions.

### **1.2.1 Operable Unit History**

The ICPP has been in operation since 1954 and has historically been an uranium reprocessing facility for defense projects and for research of spent nuclear fuel. The High Level Liquid Waste Tank Farm (HLLWTF), shown in Figure 1-2, has been in service (receiving waste) since 1954 and is an integral part of the ICPP. It provides the interim storage capacity for high-level liquid waste (HLLW) until it can be sent to the Waste Calcining Facility (WCF), or after 1982, to the New Waste Calcining Facility (NWCF), where it is solidified. After processing, the calcined, granular solids are then subsequently stored in stainless steel bins. The HLLW is regularly transferred between tanks when necessitated by space requirements, or in preparation for calcination. The tank farm consists of 18 underground stainless steel tanks with volume capacities ranging from 18,400 to 300,000 gallons. The tops of the largest tanks, having 300,000 gallon capacity, are located approximately 10 feet below land surface (bls), with their bases located at approximately 50 feet bls.

### **1.2.2 Operable Unit Description**

The HLLWTF area is relatively level over its approximately 4 acre surface area. In 1977, the tank farm area was covered with approximately two feet of soil, a synthetic membrane, and an additional six inches of soil. This action was taken to help prevent rain and melting snow from percolating into the tank farm. Within the HLLWTF, a total of eleven surface and subsurface releases of HLLW have been documented. Each of these releases have been included as an Environmentally Controlled Area (release site) within the tank farm OU. The eleven release sites are CPP-16, -20, -24, -25, -26, -28, -30, -31, -32, -83(Well 55-06) and -79; and are shown in Figure 1-3. A brief description of each release site is provided in Table 1-1.

Figure 1-1. Map of the INEL showing the location of the ICPP

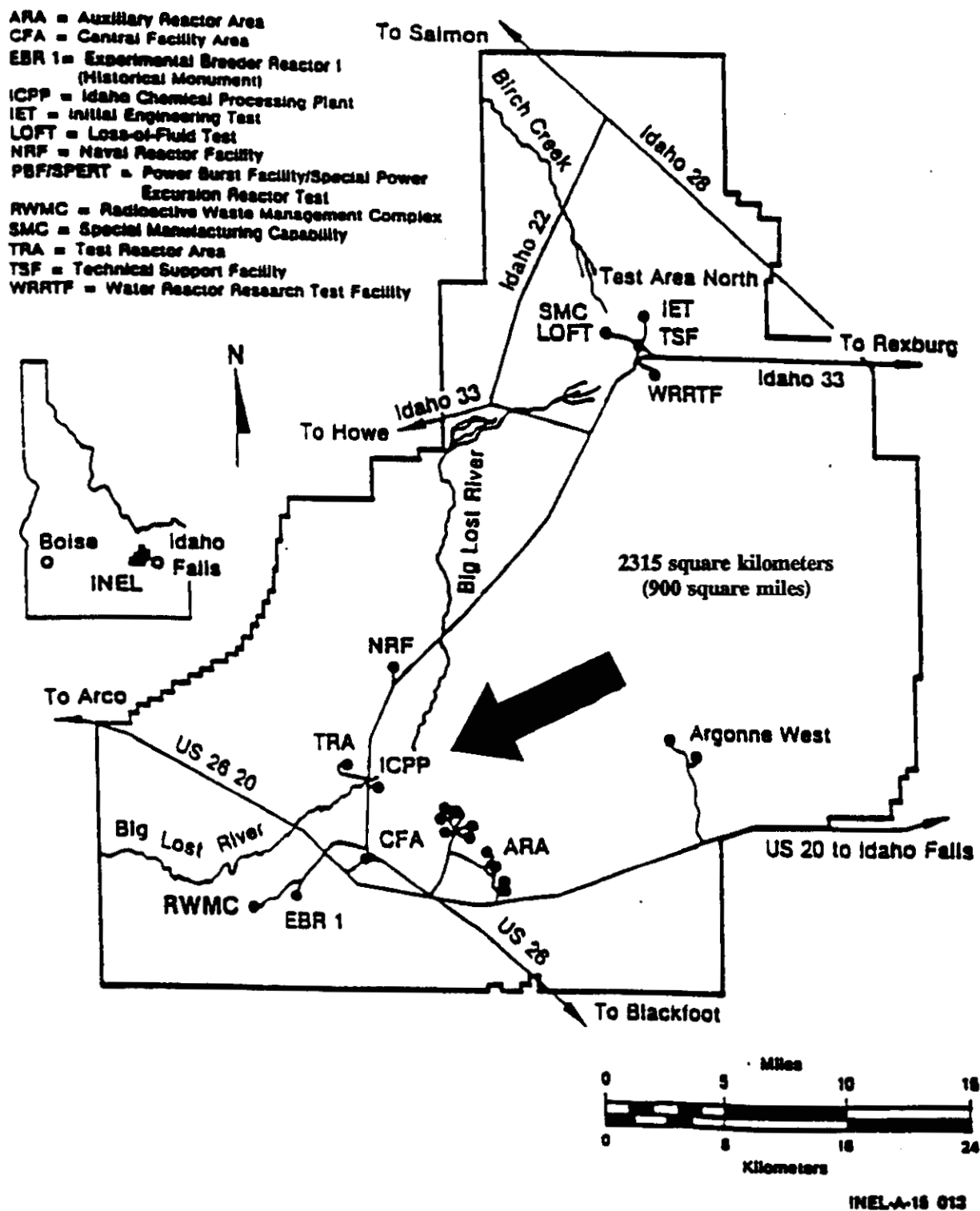


Figure 1-2. Operable Unit 3-07 and site CPP-55-06 within the ICPP

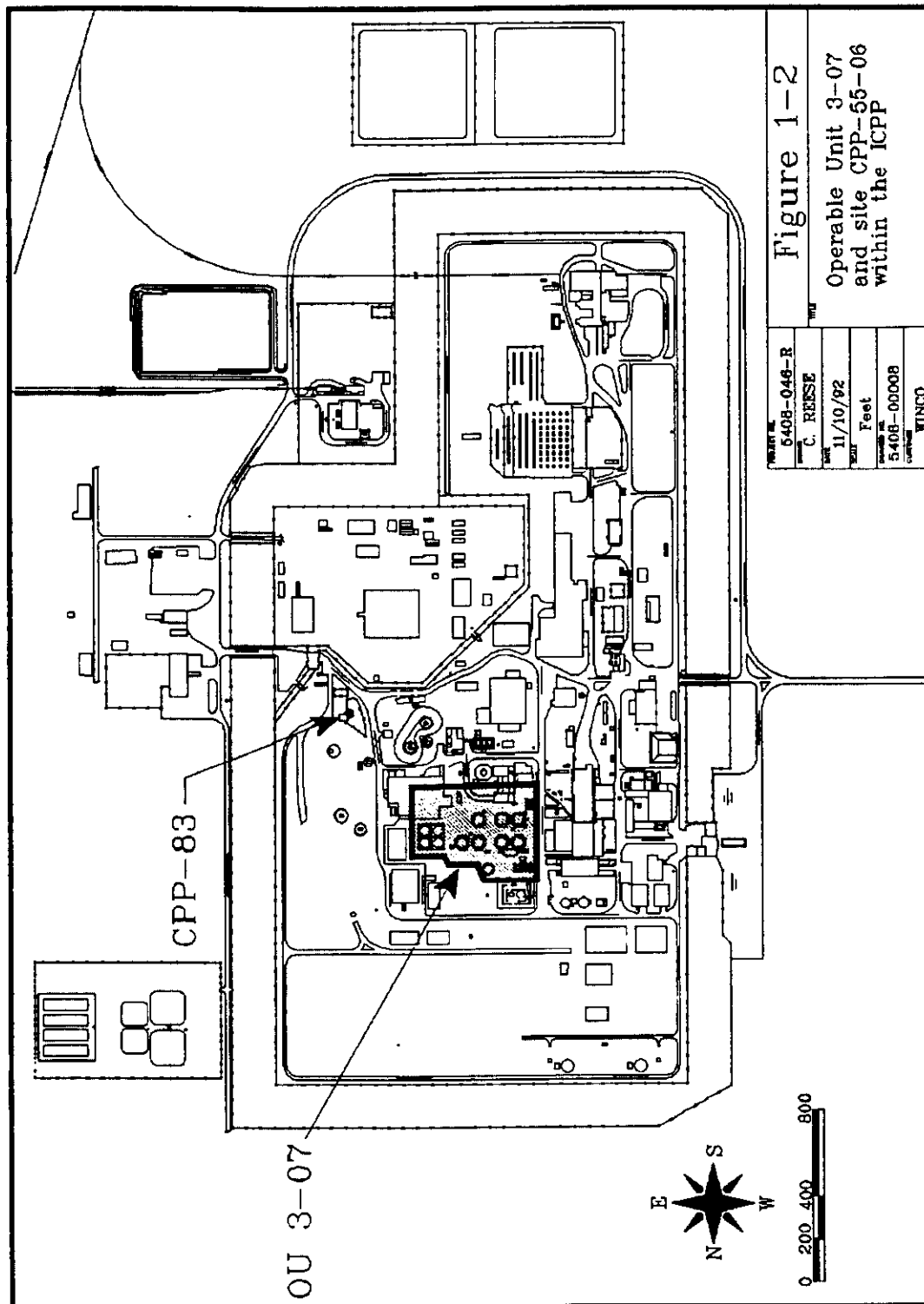


Figure 1-3. Environmentally Controlled Areas within OU 3-07

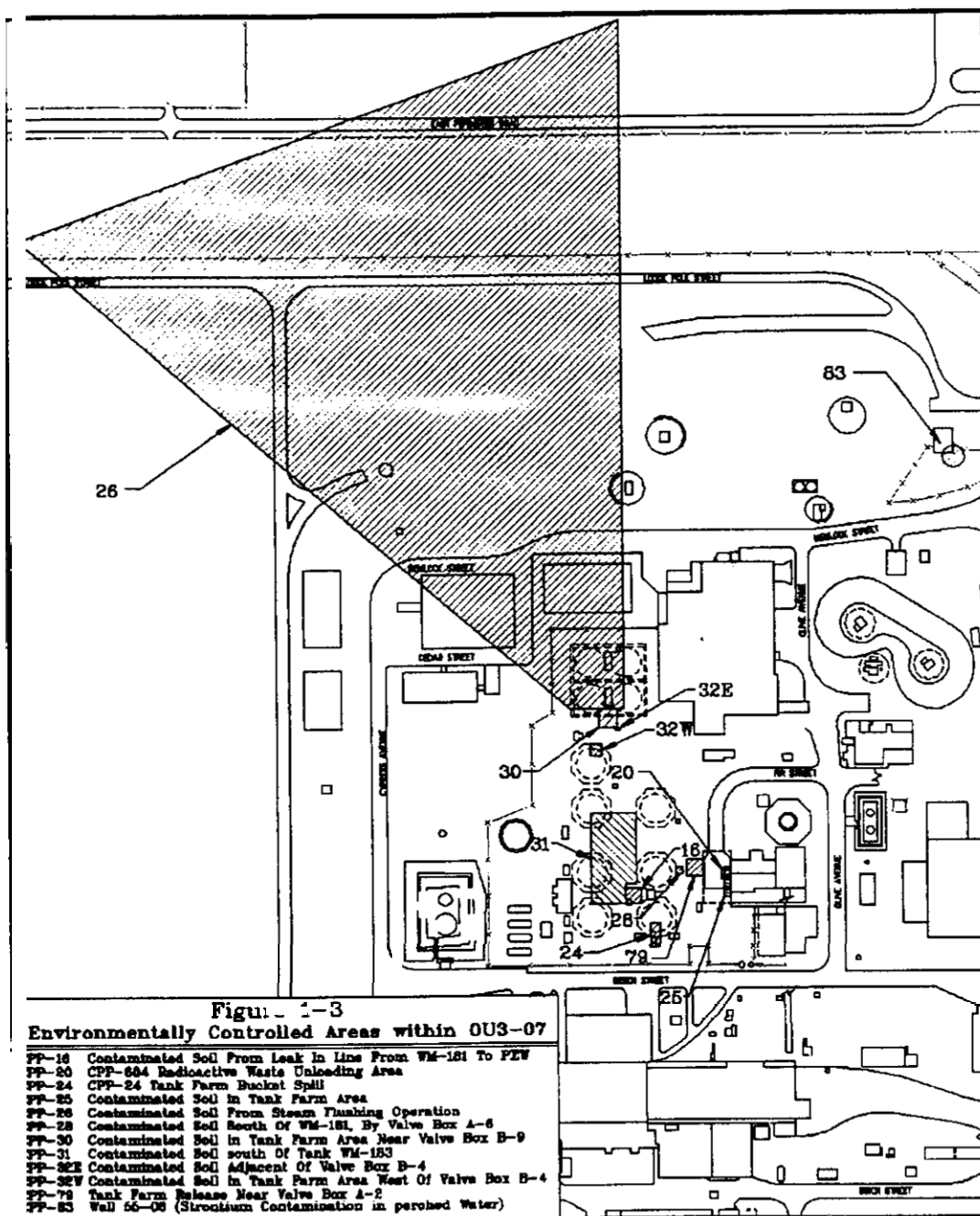


Table 1-1. Description of the Release Sites within OU 3-07

Site	Release	Date	Contamination	Cleanup
CPP-18 Contaminated soil from leak in line from WM-181 to PEW	Approximately 3000 gallons of low-level contaminated wastewater were released during a routine transfer of solution from tank WM-181 to the Process Equipment Waste (PEW) feed tank, WL-102. This release of wastewater, typically consisting of very low-level radioactively contaminated plant condensates, occurred as a single incident. The release was caused by the failure of the diversion valve flange gasket that was located in an open bottom concrete valve box at a depth of approximately 4 feet bis as shown on INEL drawings 105026 and 118445.	January 16, 1978	According to a memo of conversation between Chris Martin and Dan Steiger dated January 8, 1992, the release was estimated to have contained 1.2 curies of radioactive material. This estimate is based upon readings obtained from Thermo-Luminescent Detector (TLD) chips that were lowered through the inside of a pipe driven approximately three feet from the valve box.	According to Operating Occurrence Report number 76-3, dated January 16, 1978, this transfer line would be re-located and the valve box replaced as part of the ICPP Radioactive Waste Systems Project number 76-ID-003. During this project, the replacement of this valve box with another designated as DVB-C8 as shown on INEL drawing 137926, involved the excavation and removal of soil around the original valve box to allow for the installation of the new valve box.
CPP-20 CPP-604 Radioactive Waste Unloading Area	This release site is located to the north of building CPP-604 where occasional small spills would occur at the surface during the transfer of the liquid wastes into the storage tank. This storage tank received radioactive liquid waste from other INEL facilities.	1954-1978	According to the Initial Assessment Form, dated July 8, 1987, these spills were corrected as they occurred and the resulting contaminated soils were reportedly removed as necessary. No records exist that describe the types, quantities, and locations of the spills or to verify the effectiveness of clean-up activities.	In 1982 and 1983, the entire site was excavated as part of the Fuel Processing Facility Upgrade Project that involved the installation of valve box C-32 and tanks 132 and 133. This project involved the excavation of approximately 7053 ft <sup>3</sup> to the north of CPP-604 as shown on photographs 83-602-1-8 and 82-3471. The photographs are included in the Track 1 package and referenced here. No action on comment.
CPP-24 Tank Farm Bucket Spill	Approximately 1 gallon of radioactively contaminated solution was spilled from a bucket onto the ground while working on tank WM-180.	February 16, 1954	According to the Radioactivity Incident Report dated December 15, 1954, a surface area of approximately 3 ft x 8 ft was contaminated. Maximum reported radiation, both horizontally and vertically, from this single surface spill was 400 mR/hr beta-gamma.	The exact location of this spill is unknown and according to the entry made in the Health Physics Technician's (HPT) logbook, the contaminated soil was removed.



Table 1-1. Description of the Release Sites within OU 3-07

Site	Release	Date	Contamination	Cleanup
CPP-25 Contaminated soil in the Tank Farm Area	A ruptured transfer line, believed to be either PWA-1011 or PWA-3001, released an unknown quantity of liquid waste adjacent to building CPP-604. The release occurred during a transfer of waste from WC-119 to WL-102	August 28, 1980	According to direct radiation readings at the time of the incident (Radioactivity Incident Report, dated August 28, 1980), the soil was initially contaminated to levels of 2-4 R/hr.	As indicated in the Track 1 Decision Document, approximately nine yd <sup>3</sup> of contaminated soil were removed and taken to the Radioactive Waste Management Complex (RWMC) at the INEL. No records exist verifying the effectiveness of these clean-up activities. However, during 1982 and 1983 the entire site was excavated as part of the Fuel Processing Facility Upgrade Project that included the installation of valve box C-32 and tanks 132 and 133. This project involved the excavation of approximately 7053 ft <sup>3</sup> of soil to the north of CPP-604 as shown in photographs 83-602-1-6 and 82-3471.
CPP-26 Contaminated soil from Steam Flushing Operation	A section of the decontamination header that was used for routine preventive maintenance of the transfer lines, was being flushed with steam so that new tie-ins could be added to the header. During the steam flushing process, the facility operator discontinued the flushing after steam was observed leaking to the atmosphere from a hose coupling on the decontamination header. The steam released by this incident was presumed to be radioactively contaminated because of the transfer lines that were being flushed.	May 10, 1964	The area of contamination was based on the weather conditions on the day of the incident that included high winds. According to the report titled "Waste Tank Farm Contamination Incident of May 10, 1964", it was estimated that the cloud of steam contaminated a surface area of approximately 13 acres to the northeast of the decontamination header. The weather conditions are described in the memo dated June 12, 1964 from the U.S. Weather Bureau, which is included as an attachment to the incident report. At the time, the incident contaminated ten acres of land outside the ICPP fence.	There has been a significant amount of construction within this release site since 1964. The portion of the release site nearest to the decontamination header was excavated during the construction of buildings CPP-699 and CPP-654, during the construction of Storage Bin Sate 4, 5, and 6, and a portion of the release site also has been covered by the construction of Hemlock Street.

Table 1-1. Description of the Release Sites within OU 3-07

Site	Release	Date	Contamination	Cleanup
CPP-28 Contaminated soil south of WM-181, by Valve Box A-6	This subsurface release was caused by a 1/8-inch diameter hole that was mistakenly drilled into the 3 inch transfer line PWA-1005 during its installation in 1955. The HLLW likely leaked through the secondary containment and small quantity releases of HLLW to the soil may have occurred as early as 1955, during the initial transfer of HLLW through this line. It was estimated that approximately 120 gallons of first-cycle raffinate waste containing an estimated 8,000 curies of gross radioactivity was released from the pipe between 1955 and 1974.	Discovered October 1, 1974	According to the 1974 report, an estimated 4.7 yd <sup>3</sup> of contaminated soil having 3,000 curies of gross activity was left in place in an area approximately nine feet in diameter by two feet in average depth below the pipe encasement.	An attempt to locate and remove the contaminated soil began on October 21, 1976. A total of 58 yd <sup>3</sup> of contaminated soil containing an estimated 3000 curies of mixed fission products were removed and transported to the RWMC.
CPP-30 Contaminated soil in Tank Farm Area near Valve Box B-9	This contamination was caused by maintenance personnel working inside a contaminated valve box who inadvertently radioactively contaminated equipment and clothing on the ground.	June 2, 1975	A 20 ft x 20 ft area of soil between valve boxes B-5 and B-9 was contaminated to levels up to 1 R/hr.	The contaminated soil was removed and placed into four 55-gallon drums and shipped to the RWMC for disposal. No records exist verifying the effectiveness of the removal. The 1991 and 1992 surface radiation surveys of the area did not show radioactive contamination above background levels.
CPP-31 Contaminated soil south of tank WM-183	An investigation into the source of the contamination revealed that in November 1972, approximately 14,000 gallons of HLLW were released to the surrounding soil during a transfer between tank WM-181 to WM-180. The release was caused by the failure of a 3-inch diameter WRN-1037 carbon steel waste transfer line where it was speculated that the highly acidic HLLW corroded the transfer line and ultimately led to the subsurface release.	Discovered September 18, 1975	The extent of the contamination was estimated in 1975 using the results of direct beta-gamma radiation measurements from several holes drilled in the area. The estimated volume of contaminated soil is approximately 200 yd <sup>3</sup> in the 10 rem/hr range and 400 yd <sup>3</sup> in the 1 rem/hr range.	None documented
CPP-32 During the review of the historical file of CPP-32, a discovery was made that two different releases occurred in the area originally identified. The two locations are approximately 50 feet apart. In order to distinguish the two incidents, the sites have been designated CPP-32E and CPP-32W. The following provides information regarding the two sites.				
CPP-32E Contaminated soil adjacent to Valve Box B-4	The release is believed to have originated from condensed moisture inside the valve box that accumulated on the stand pipe and later dripped onto the ground below.	Discovered December 1976	The area of contaminated surface soil is approximately 4 ft. x 2 ft. and had radiation measured in the area to a depth of 12 inches as high as 2 R/hr beta-gamma.	None documented

Table 1-1. Description of the Release Sites within OU 3-07

Site	Release	Date	Contamination	Cleanup
CPP-32W Contaminated soil in Tank Farm Area west of Valve Box B-4	The contamination is believed to have originated from a 2 inch above-ground transfer line that released radioactive liquid approximately 50 ft northwest of Valve Box B-4.	Discovered December 1978	An area of approximately 3 ft. by 2 ft. having radiation levels as high as 2 R/hr.	None documented
CPP-78 Tank Farm Release near Valve Box A-2	During ICPP plant operations, overhead condensates are routinely transferred from the WCF to the PEW feed tank, WL-102. Two of these transfers, one in July 1978 and the other in August 1978, resulted in the loss of approximately 2500 gallons of low-level radioactive contaminated condensate. The release occurred when the condensate was obstructed in the transfer line and backed up through an open drain line and into valve box A-2. The condensate subsequently leaked out of the valve box and onto the underlying soil through cracks in the split tile encasement around the transfer lines exiting the valve box.	July 1978 August 1978	The extent of contamination is unknown. However, the estimated volume released is 2500 gallons of low level radioactive liquid waste.	None documented

Table 1-1. Description of the Release Sites within OU 3-07

Site	Release	Date	Contamination	Cleanup
<p>CPP-83 (Well 55-06)</p>	<p>A release site (Well 55-06) has been identified based on contaminated perched ground water, primarily Sr-90, encountered by well 55-06. This well, installed in 1990, is located approximately 550 feet southeast of the tank farm and is completed in the shallow perched ground water created by a low permeable layer at a depth of approximately 110 feet bls.</p> <p>The contamination in the "110 foot" perched ground water was first discovered during the drilling of a deep borehole to characterize Land Disposal Unit (LDU) CPP-55 (Mercury Contaminated Area) under the Consent Order/Compliance Agreement (COCA). The borehole initially encountered radiological contamination at a depth of 60.7 feet bls and the contamination was present in the clay infilling to a depth of approximately 118 feet bls. The total depth of the borehole was 123 feet bls. Since water was encountered at depth, this borehole was completed as a 2-inch diameter monitoring well, designated as 55-06, having a screened interval from 93.1 feet to 113.1 feet bls.</p>	<p>Discovered 1990</p>	<p>Perched ground water contaminated with radionuclides, primarily Sr-90.</p>	<p>None documented</p>

### 1.3 Report Organization

This Summary Report compiles the available information on OU 3-07, Tank Farm I. The outline for the report is consistent with the information required in the new Track 2 Guidance. There is some variation with regard to the location of specific sections; however since the draft report was completed at the time of the new guidance (i.e. EG&G Presentation, December 16, 1992) the format was not changed. It should be noted that as per the new guidance (12/16/93), this report does not include the Form 1 analytical data as an Appendix. It is our interpretation that this information will be available to the public and regulators through the project files.

The following is a description of the various sections included in this report:

Section 1: Introduction; Describes the purpose, background and organization of the Summary Report.

Section 2: Operable Unit Investigation; Presents the Site Status, Summary of Field Sampling Plan Objectives and Sampling Protocol and discusses Quality Assurance/Quality Control. The purpose of this section is to document scoping decisions (i.e. sites requiring no further field investigation) and summarize field sampling activities.

Section 3: Summary of Risk Assessment Methodology; This Section summarizes the Contaminants of Concern, Toxicity Assessment and Exposure Assessment and is intended to document all assumptions used in the risk calculations.

Section 4: Results of the Track 2 Investigation (OU 3-07) and Risk Assessment; This Section presents the results of the Track 2 Investigation and an evaluation of the associated risk posed to human health from each site.

Section 5: Perched Ground Water at Site CPP 55-06; This section describes the field activities associated with site CPP 55-06 and the associated conclusions. This site was included in a separate section due to the fact that a risk calculation was not intended to be made. Rather an evaluation of existing conditions which included an additional round of sampling and water level measurements.

Section 6: Summary and Recommendations; This section summarizes the results from the Track 2 investigation and provides recommendations for each site within the Operable Unit.

Section 7: References; This section provides a listing of the references used in the report.

Appendices: The appendices consist of supporting documentation used in preparation of the Summary Report. These appendices include the following: Appendix A, Track 1 Decision Documents for Sites CPP-16, -20, -24, -25, -30 and -32W; Appendix B, Borehole Logs; Appendix C, Screening Criteria to Identify Contaminants of Potential Concern; Appendix D, Parameters and Health Effects for Site Contaminants; Appendix E, Analytical Results from the Perched Water Sampling; and Appendix F, Model Results from GWSCREEN.

## **2.0 OPERABLE UNIT INVESTIGATION**

This section describes the planning and field activities associated with the Track 2 investigation at OU 3-07. It includes a discussion of the scoping process for all sites, including those sites recommended for No Further Field Investigation (NFFI) based on the Track 1 Decision Document. For each site requiring the collection of additional data, the Data Quality Objectives (DQOs) and associated Track 2 investigation and implementing procedures are provided. Finally, this section also provides a discussion of the results from the data validation and a summary as to whether the project's DQOs were met. This section is organized as follows:

- Section 2.1 - Describes the Track 2 scoping decision process for the sites recommended for NFFI.
- Section 2.2 - Describes the Track 2 decision process and the DQOs for the sites recommended for the Track 2 investigation.
- Section 2.3 - Summarizes the field procedures and data collection activities associated with the Track 2 investigation.
- Section 2.4 - Describes the Quality Assurance/Quality Control (QA/QC) associated with the project and the attainment of the DQOs.

### **2.1 Scoping Process - No Further Field Investigation Sites**

Based on the results from the Track 1 assessments, six sites were recommended for NFFI. These sites include CPP-16 (contaminated soil from leak in line from WM-181 to PEW), CPP-20 (CPP-604 Radioactive Waste Unloading Area), CPP-24 (Tank Farm Bucket Spill), CPP-25 (Contaminated Soil in Tank Farm Area), CPP-30 (Contaminated Soil in Tank Farm Area near Valve Box B-9), and CPP-32W (Contaminated Soil in Tank Farm Area West of Valve Box B-4). This recommendation was based on a qualitative risk assessment that determined the risk to the maximum-exposed individual from site contaminants is not unacceptable, within an acceptable amount of uncertainty.

The section summarizes the rationale for each NFFI recommendation and discusses the critical assumptions inherent with the recommendation. A complete description and the supporting documentation are provided in the Track 1 Decision Documents (Appendix A). The rationale for each site's NFFI determination is summarized in Table 2-1 and described in more detail below.

#### **2.1.1 CPP-16**

In November 1992, additional information concerning site CPP-16 was obtained. After reviewing this information it was determined that the contaminated soil may not have been completely removed during the ICPP Radioactive Waste Systems Project. As a result, the potential contamination at this site and its effect upon human health has been re-evaluated using the Track

**Table 2-1. Summary of the Rationale for the No Further Field Investigation (NFFI) Determination**

Site	Description	Scoping Determination	Rationale
CPP-16	Release of low-level contaminated liquid waste in 1976.	no further field investigation <sup>1</sup>	
CPP-20	Occasional liquid waste spills next to CPP-604.	no further field investigation <sup>1</sup>	Removal of contaminated soil in 1982 and 1983 during Phase I & II of FPFU project.
CPP-24	1 gallon release in 1954.	no further field investigation <sup>1</sup>	Removal of contaminated soil by the Health Physics Technician (HPT) following release.
CPP-25	Release of liquid waste in 1960.	no further field investigation <sup>1</sup>	Removal of contaminated soil subsequent to release and also during FPFU project in 1982 and 1983.
CPP-30	20' x 20' area of contaminated soil between valve boxes B-5 & B-9. Occurred in 1975.	no further field investigation <sup>1</sup>	Removal and disposal of contaminated soil. Subsequent radiation surveys do not indicate radiation above background.
CPP-32W	3' x 2' area of contaminated soil that occurred in 1976.	no further field investigation <sup>1</sup>	Surface radiation surveys in 1991 did not identify radiation above background.

**NOTES:**

1. Residual radioactive contamination due to the policy of using <3mR/hr contaminated fill material will be addressed in more detail in the comprehensive WAG RI/FS.



2 scoping process presented at a December 16th meeting by EG&G. After conducting a pathway assessment of the residual contamination at this site where it is located 9 feet and 3 inches bls., the only complete pathway was ground water ingestion (GWSCREEN outputs for all sites are included as Appendix F.) An evaluation of the exposure via ground water ingestion to site contaminants determined that the risk to human health was not unacceptable and within an acceptable level of uncertainty. This pathway assessment is provided in the Track 1 Decision Document for this site (Appendix A). These findings led to a recommendation of no further field investigation at this site in the Track 2 scoping process.

**2.1.1.1 Critical Assumption.** The critical assumption that led to the recommendation of no further field investigation at this site is that the top of the contaminated soil is located at 9 feet and 3 inches bls or possibly to 10 feet due to overexcavation at the site for access capability. This depth to contamination is at the cut off point for the exposure depth used in the Track 2 evaluation.

### **2.1.2 CPP-20**

The NFFI recommendation is based on the complete removal of surface soil that may have been contaminated during excavations as part of the Phase I and Phase II FPFU Project. During Phase I, the entire area was excavated to a depth of 40 feet and according to available information, only soil having radiation of 5 mR/hr or less was used as backfill in the bottom ten feet of the excavation. The remainder of the excavation was filled with clean soil that is believed to have been imported from the Central Facilities Area (CFA) gravel pits. Since the release of contamination, this site has undergone two extensive excavations during these upgrade projects occurring in 1982 and 1983. There are no records to verify the effectiveness of the removal, however the entire area to the north of CPP-604 that was the unloading area was excavated to a depth of 40 feet during the upgrade projects. As a result, this would have removed any contaminated surface soil that remained. The excavations are documented by photographs (83-602-1-6 and 82-3471) of the area taken during the FPFU Project which clearly show the extent of soil removal at this site. Effects of backfilling with soil having radiation of 5mR/hr or less will be evaluated during the comprehensive RI/FS.

**2.1.2.1 Critical Assumptions.** The critical assumptions that led to the NFFI recommendation at this site are: 1) that the contaminated surface soil from occasional spills during the transfer of low-level liquid waste at this site was completely removed during the excavations to a depth of 40 feet that occurred during the Phase I and Phase II of the FPFU Project, and 2) that the potential contamination from this site did not migrate below the depth of the excavation.

Although there are no records to verify the effectiveness of the cleanup measures, the radiological survey of this area in 1990-1991 did not detect radiation levels above background levels. The results from the surface radioactivity measurements at the ICPP for 1990-1991 are included in the Track 1 Decision Document.

### 2.1.3 CPP-24

The NFFI recommendation is based on the Radioactive Incident Report that was written following the release. According to the entry made in the HPT logbook, cleanup measures were taken after the incident that included a partial, if not complete, excavation and removal of the contaminated soil affected by the spill. Although the precise location of this site is unknown, a radiological survey of the area performed in 1990-1991 did not detect radiation levels above background levels in the vicinity of the area of contamination.

**2.1.3.1 Critical Assumptions.** The critical assumptions that led to the NFFI recommendation at this site are: 1) that the decontamination efforts after the incident were successful, and 2) if the decontamination efforts were not successful, any residual contamination would have been discovered during the radiological survey of the area in 1991. The results from the surface radioactivity measurements at the ICPP for 1990-1991 are included in the Track 1 Decision Document.

### 2.1.4 CPP-25

The NFFI recommendation is based on the removal of 9 yd<sup>3</sup> of contaminated soil following the release and the extensive excavation of this site as part of later upgrade projects. According to documentation, 9 yd<sup>3</sup> of contaminated soil were removed following the release and transported to the RWMC. There are no records to verify the effectiveness of this removal. However, any residual contaminated soil that was not removed during the initial cleanup would have been removed by the extensive excavations that occurred during the Phase I and II of the FPFU Project. These excavations removed soil to install Tanks 132 and 133 that went to depth of 40 feet bls. Photographs of the area during the FPFU excavations (83-602-1-6 and 82-3471) clearly show the excavated area at the former location of the contaminated soil.

**2.1.4.1 Critical Assumptions.** The critical assumptions that led to the NFFI recommendation at this site are: 1) the majority of the contamination was removed following the release, and 2) any residual contamination would have been removed during the subsequent excavations to depth of 40 feet bls that occurred as part of the Phase I and Phase II FPFU Project. Although no records exist to verify that cleanup of the spills took place, interviews with the FPFU project personnel indicate that the only contamination encountered during the excavation was found away from the release location near valve box C-30, 40 ft. bls. This would indicate that there is a high potential that the original contamination was cleaned up as reported.

### 2.1.5 CPP-30

The NFFI recommendation is based on the Significant Operating Occurrence Report (SOOR) that states the contaminated surface soil was removed and placed into four 55-gallon drums for disposal at the RWMC. No records exist verifying the effectiveness of the cleanup, however, the 1991 and 1992 surface radiation surveys showed that radioactive contamination was at or below background levels.

**2.1.5.1 Critical Assumptions.** The critical assumptions that led to the NFFI recommendation at this site are: 1) that the decontamination measures taken after the incident were effective, and 2) that if the decontamination measures were only partially effective, the presence of residual contamination would have been detected by subsequent surface radiation surveys.

#### **2.1.6 CPP-32W**

The NFFI recommendation is based on the location of the release that is only approximately known and would require a significant number of boreholes to better define the location of the release and thus, damage the membrane currently over the HLLWTF. Any investigations performed at this site has therefore been deferred to the comprehensive WAG RI/FS.

### **2.2 Summary of Field Sampling Plan Objectives**

The objective for the Track 2 investigation at OU 3-07 was not to fully characterize the nature and extent of contamination at each site, but to collect sufficient information to evaluate the risk to human health using the methodology provided in the Track 2 Guidance Document (DOE/ID-10389, Rev. 3). This was accomplished through a limited field investigation of specific areas within each release site where the highest contamination was expected (i.e., near the point of release). In addition to determining the highest concentration of the most likely contaminants to be encountered, the analyses selected for the Track 2 investigation included other suspected waste stream contaminants that may have been released at the site. By analyzing for all possible contaminants, the results from this investigation should determine the contaminants of potential concern for inclusion in future investigations, if any are required.

The DQOs for the Track 2 investigation targeted three sites (CPP-26, CPP-32E, and CPP-79) for the collection of soil samples for chemical and radiological analysis. The results from the soil samples were intended to determine the presence or absence of radiological contamination at each site and to increase the overall reliability of the exposure concentrations for any contaminants detected in the soil. In addition to collecting subsurface soil samples, a limited field investigation was also performed at sites CPP-28 and CPP-31 to better characterize the extent of contamination through subsurface radiation measurements in existing "observation wells". The decision to utilize existing "observation wells" rather than installing additional "observation wells" was based upon possible damage to the tank farm containment structure by the dynamic and static forces induced during driving new "observation wells". Finally, an investigation into the quality of the perched ground water near the tank farm from both the wells (especially 55-06) and the lysimeters was also implemented. This sampling effort was performed in conjunction with the quarterly monitoring being performed under DOE Order 5400.1. A summary of the DQO's for the Track 2 investigation at OU 3-07 is provided in Table 2-2.

Table 2-2. Summary of Data Quality Objectives for the Track 2 Investigation at OU 3-07

SITE	OBJECTIVE	REQUIRED ACTIVITY	CRITICAL SAMPLES	RATIONALE	TRACK 2 ACTIVITY
CPP-26	Identify the presence/absence of contamination and better estimates of exposure concentrations for radionuclides, metals, and VOCs in the soil.	<ul style="list-style-type: none"> <li>- Drill up to three boreholes and field screen the cuttings for beta-gamma radiation. Collect two soil samples from each borehole having the highest measured radiation and analyze for radionuclides, VOCs, and metals.</li> </ul>	The sample taken from the highest radiation concentration within the first two meters from each borehole.	<p>To assess the risk from this site, one borehole will be drilled to a depth of six feet and located to the east of building CPP-635 (CPP-26-1; Figure 2-1). If contamination is detected in this borehole based on field radiation measurements, two additional boreholes (CPP-26-2 and CPP-26-3) are to be drilled on both sides of the original borehole. These borehole locations correspond to the area of the original steam contamination and are situated in an area where the liquids were described as puddling on the ground. The borehole depth of six feet was selected to ensure that the area of possible contamination was intercepted and takes into account the 2 ½ feet of soil cover emplaced in conjunction with the membrane liner in 1978.</p>	<p>Boreholes:</p> <ul style="list-style-type: none"> <li>- CPP-26-1</li> <li>- CPP-26-2</li> <li>- CPP-26-3</li> </ul>

Table 2-2. Summary of Data Quality Objectives for the Track 2 Investigation at OU 3-07

SITE	OBJECTIVE	REQUIRED ACTIVITY	CRITICAL SAMPLES	RATIONALE	TRACK 2 ACTIVITY
CPP-28	Attempt to locate the existing "observation wells" and if successful, determine whether vertical migration has occurred since the last data set.	- Attempt to initially locate the "observation wells" through an evolution of historic photographs and surface geophysical techniques. Once a target area is identified, excavate the area to locate the "observation wells". Finally, profile the radiation in the existing "observation wells".	None collected	According to the description in the Significant Operating Occurrence Report (74-27), a total of eleven "observation wells" were installed around the release and radiation measurements from these "observation wells" adequately defined the area of contamination. These "observation wells" may have been plugged and abandoned during the installation of the tank farm membrane in 1978. The objective of the Track 2 investigation is to attempt to locate these "observation wells" by excavating the soil below the tank farm membrane. Once located, the "observation wells" would be extended to the land surface to provide subsurface access points for future radiation monitoring.	- Trenching operation performed on August 20-24, 1992.

Table 2-2. Summary of Data Quality Objectives for the Track 2 Investigation at OU 3-07

SITE	OBJECTIVE	REQUIRED ACTIVITY	CRITICAL SAMPLES	RATIONALE	TRACK 2 ACTIVITY
CPP-31	Determine if vertical migration has taken place since the last data set.	- Profile radiation in selected existing "observation wells".	None collected	Several existing "observation wells" have been monitored for radioactivity since 1975. The accuracy and precision of these historical measurements however, cannot be assured since a QA/QC program was not in place. Therefore, the objective of the Track 2 investigation is to collect subsurface radiation dose measurements of a known and documented quality from these "observation wells" for use in the Track 2 risk assessment.	- Radiation profile measurements performed on August 18, 1992.
CPP-32E	Identify the presence/absence of contamination and if detected, provide better estimates of exposure concentrations for radionuclides, metals and VOCs in soils.	- Drill one borehole and field screen the cuttings for beta-gamma radiation. Collect two soil samples having the highest radiation and analyze for radionuclides, VOCs, and metals.	The sample taken at the two meter depth or the highest radiation measured within the first two meters.	To assess the risk at this site, one borehole will be drilled to a depth of six feet and located as close as possible to the vent tube suspected of causing the contamination (Figure 2-2). From this soil boring, two soil samples will be collected from the zone(s) indicating the highest radiation based upon field instrument measurements. It is expected that the analytical results from this borehole would indicate the maximum concentrations of contaminants to be encountered at this site and as a result, conservatively estimate the risk to human health.	<u>Borehole:</u> - CPP-32E-1

Table 2-2. Summary of Data Quality Objectives for the Track 2 Investigation at OU 3-07

SITE	OBJECTIVE	REQUIRED ACTIVITY	CRITICAL SAMPLES	RATIONALE	TRACK 2 ACTIVITY
CPP-79	Identify the presence/absence of contamination and if detected, provide better estimates of exposure concentrations for radionuclides, metals and VOCs in soils.	<ul style="list-style-type: none"> <li>- Drill one borehole to the bottom of contamination or if contamination is not detected, to a maximum depth of 25 feet. Collect continuous California split-spoon soil samples through the contaminated zone. If the contaminated zone is greater than 10 feet, collect 4 soil samples in contamination (2 bracketing zone and two in the zone).</li> </ul>	One sample taken in the zone of the highest radiation and one sample taken at the bottom of the borehole to ensure full evaluation of the depth of contamination.	<p>Since the exact location of the leak in the transfer line is unknown, full characterization of this site would require several soil borings in order to collect sufficient information for a Track 2 risk assessment. Given the constraints caused by the underground utilities, only one location could be safely drilled within the suspected area of contamination (Figure 2-3). To maximize the amount of subsurface information collected at this location, the borehole will be drilled to a depth of 25 feet, or the bottom of contamination, if detected.</p>	<p>Borehole: - CPP-79-1</p>

Table 2-2. Summary of Data Quality Objectives for the Track 2 Investigation at OU 3-07

SITE	OBJECTIVE	REQUIRED ACTIVITY	CRITICAL SAMPLES	RATIONALE	TRACK 2 ACTIVITY
CPP-83 (Well 55-06)	Determine current ground water quality in well 55-06.	<ul style="list-style-type: none"> <li>- Collect ground water samples for radionuclides, metals, pH, SC, TOC, TOX, chlorinated pesticides, chlorinated herbicides, anions, total alkalinity, sulfate, fluoride, and nitrate/nitrite.</li> </ul>	None	Collect an additional round of water samples for analysis to assist in determining whether the contaminant concentration are increasing or decreasing.	-Sample 55-06
	Determine current ground water quality and variations in contaminant concentrations and water level	<ul style="list-style-type: none"> <li>- Collect ground water samples for radionuclides, metals, pH, SC, TOC, TOX, chlorinated pesticides, chlorinated herbicides, anions, total alkalinity, sulfate, fluoride, and nitrate/nitrite.</li> </ul>		Collect water samples and water level measurements from other tank farm wells and lysimeters to determine the spatial distribution of contamination in the perched water body.	<u>Wells</u> <ul style="list-style-type: none"> <li>- Well TF-1</li> <li>- Well TF-2</li> <li>- Well TF-3</li> <li>- Well TF-4(E)</li> </ul> <u>Lysimeters</u> <ul style="list-style-type: none"> <li>- TF-1</li> <li>- TF-2</li> <li>- TF-3</li> <li>- TF-5</li> </ul>



Figure 2-1. Location of the Boreholes at Site CPP-26

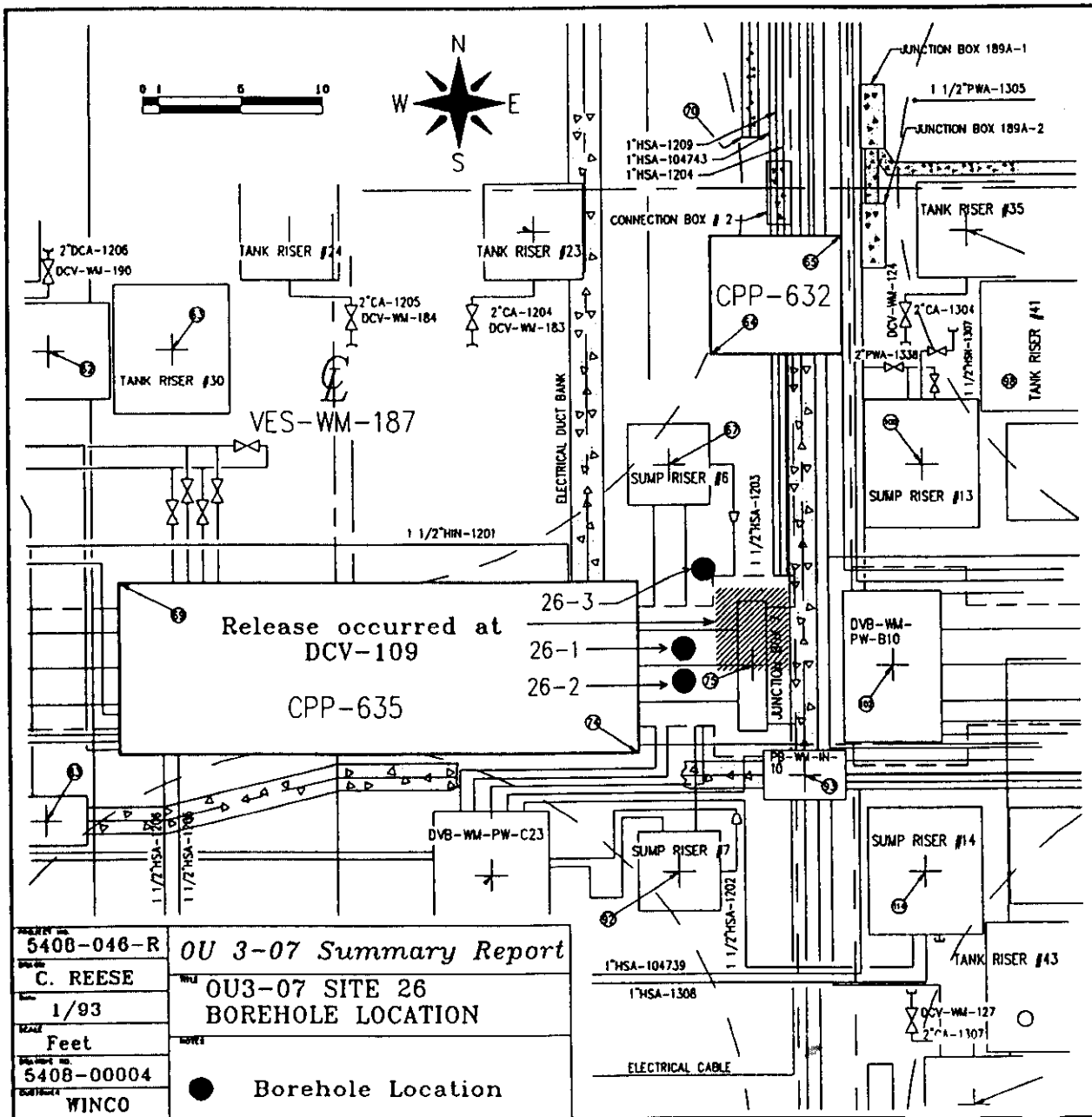
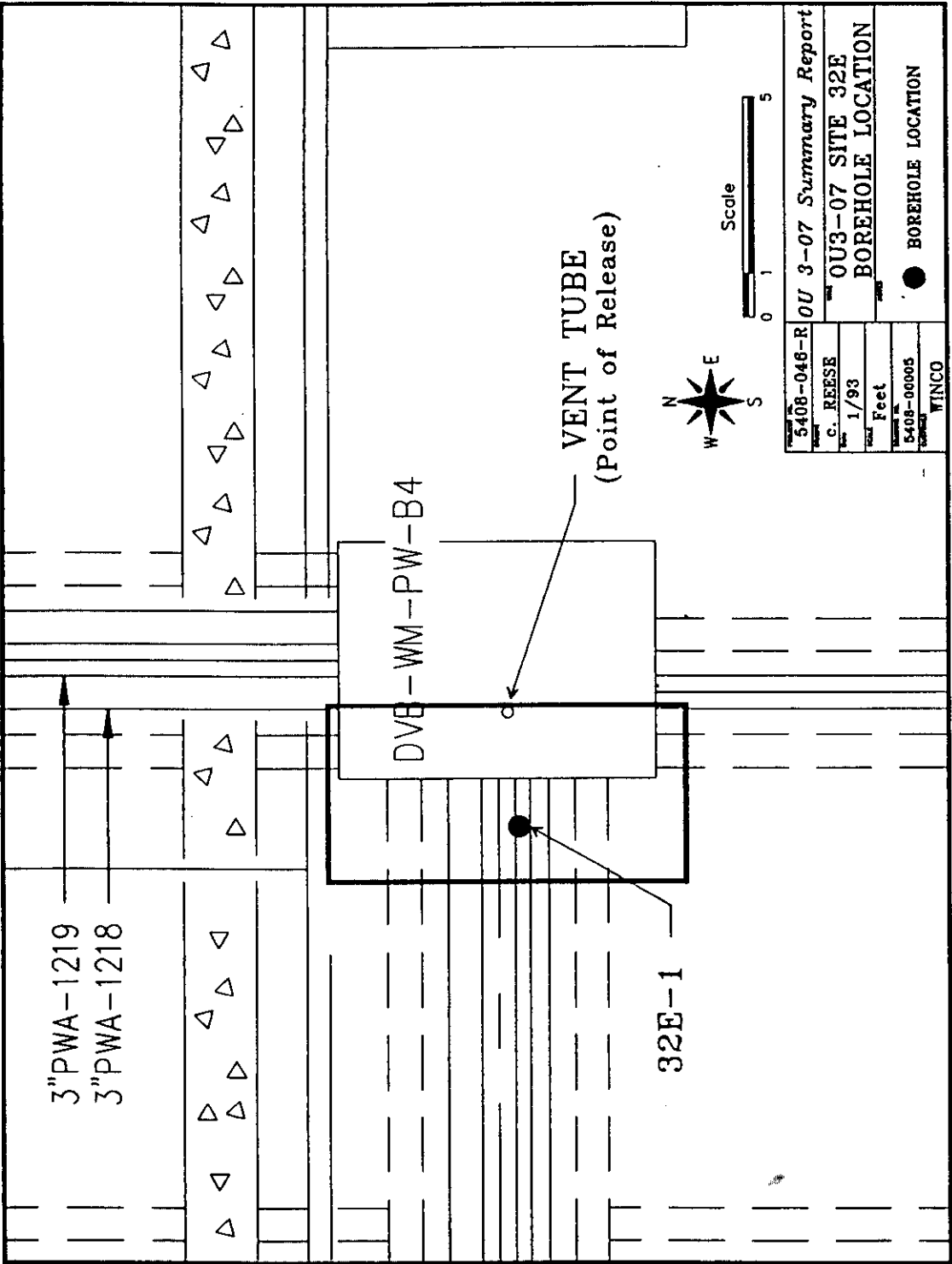
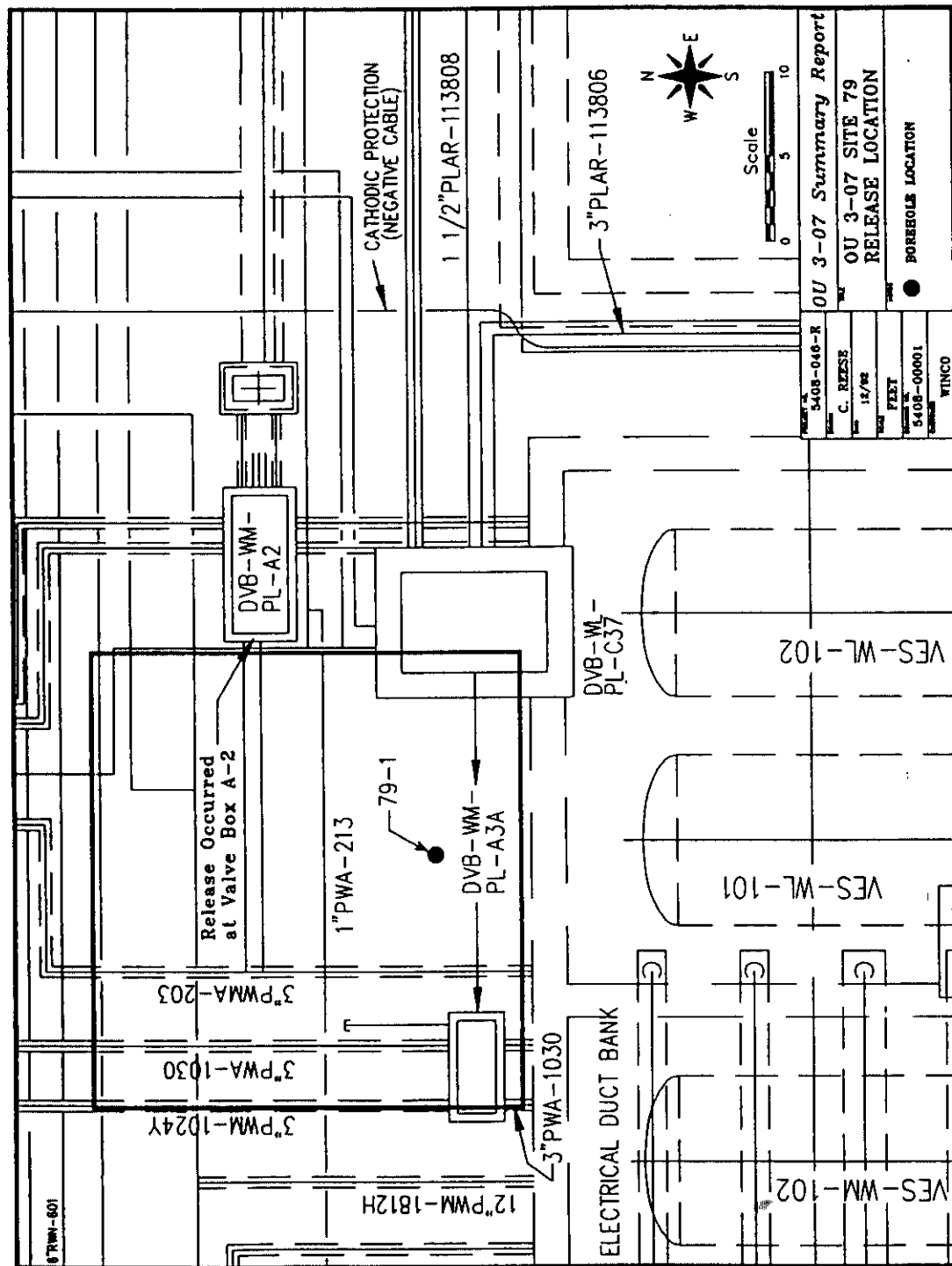


Figure 2-2. Location of the Borehole at Site CPP-32E



**Figure 2-3. Location of the Borehole at Site CPP-79**



## 2.3 Summary of Field Sampling

Soil samples for chemical and radiological analyses were collected from four soil borings (CPP-26-1, CPP-26-2, CPP-26-3, and CPP-32E-1) that were hand augered to a depth of approximately six feet bls using a stainless steel hand auger and from one soil boring (CPP-79-1) drilled to a depth of 41.3 feet bls using a hollow stem auger drill rig equipped with California split-spoon samplers. The lithologic descriptions from each of these boreholes, including the results from the field organic and radiation measurements, are provided in the Borehole Logs (Appendix B). From these boreholes, soil samples were collected in accordance with the specifications provided in the *Field Implementation Document*.

A total of 18 soil samples were collected from the five boreholes as shown in Table 2-3. Of these soil samples, 13 were collected as biased grab samples from the drilled intervals having the highest beta/gamma radiation according to field measurements using a hand-held frisker. In addition, one soil sample from each borehole (five samples total) were submitted to the analytical laboratory as field duplicates. Finally, a total of nine quality assurance samples (three equipment rinsate blanks, three field blanks, and three trip blanks) were submitted to the laboratory for analysis. The equipment rinsate blanks and the field blanks were analyzed for all constituents of concern, but the trip blank was only analyzed for volatile organic compounds. A summary of the sample description, sample date, sample location, and laboratory analysis is also provided in Table 2-3.

### 2.3.1 Laboratory Analyses

Twin Cities Testing (TCT)-St. Louis and Babcock and Wilcox (B&W) of Lynchburg, VA were contracted by the EG&G Sample Management Office to perform the chemical and radiological analysis on the soil samples, respectively. In accordance with the required chemical parameters, soil samples were analyzed for volatile organic compounds (SW846/8240), fluoride (USEPA method 300.0), nitrate/nitrite (USEPA methods 353.1 and 353.2, respectively), pH and metals (Cd, Cr, Ni, and Mn by SW846/6010; and Hg by SW846/7471). A complete listing of the volatile organic and inorganic compounds analyzed, including the method detection limit (MDL), is provided in Table 2-4.

If the concentration from the total metals analysis exceeded the regulatory derived concentrations for TCLP by a factor of twenty or greater, the sample was then analyzed by TCLP to determine if the soil is classified as RCRA hazardous.

The 20:1 ratio for the total metals concentration to the TCLP concentration is based on the ratio of extraction fluid to waste described in TCLP. According to this method, the weight of extraction fluid is calculated by:

$$\text{Weight of Extraction Fluid} = \frac{(20 \times \text{percent solids}) \times \text{weight of waste filtered}}{100} \quad (1)$$

Table 2-3. Sample and Analysis Plan Table for OU 3-07

SAMPLING AND ANALYSIS PLAN TABLE FOR CHEMICAL AND RADIOLOGICAL ANALYSES																													
TABLE 2.3				Revision: 0.1				Project: OUS-7 Summary Report				Project Manager: Carol Mancoske				Page 1 of 2					From No: SAP11A								
SAP Number:				Date: 1/15/93																									
SAMPLE DESCRIPTION						SAMPLE LOCATION			ENTER ANALYSIS TYPES (AT) AND QUANTITY REQUESTED																				
SAMPLE NUMBER	SAMPLE TYPE	MEDIA	COLL. TYPE	SAMPLE METHOD	SAMPLE DATE	AREA	LOCATION	TYPE OF LOCATION	DEPTH (ft)	AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20
30700101	REG	Subsurface Soil	RIGR	Handgr.	8/18/92	KCP	CPE-26-1	Boothole	1.8 - 4.7	1																			
30700201	REG	Subsurface Soil	RIGR	Handgr.	8/19/92	KCP	CPE-26-1	Boothole	5.5 - 6	1																			
30700301	OC	Subsurface Soil	DUP	Handgr.	8/19/92	KCP	CPE-26-1	Boothole	5.5 - 6	1				1 (1)															
30700401	REG	Subsurface Soil	RIGR	Handgr.	8/19/92	KCP	CPE-26-2	Boothole	4.0 - 4.7	1																			
30700501	REG	Subsurface Soil	RIGR	Handgr.	8/19/92	KCP	CPE-26-2	Boothole	5.7 - 6.1	1																			
30700601	OC	Subsurface Soil	DUP	Handgr.	8/19/92	KCP	CPE-26-2	Boothole	4.0 - 4.7	1																			
30700701	REG	Subsurface Soil	RIGR	Handgr.	8/20/92	KCP	CPE-26-3	Boothole	1.0 - 1.8	1																			
30700801	REG	Subsurface Soil	RIGR	Handgr.	8/20/92	KCP	CPE-26-3	Boothole	1.8 - 2.7	1																			
30700901	OC	Subsurface Soil	DUP	Handgr.	8/20/92	KCP	CPE-26-3	Boothole	1.8 - 2.7	1																			
30701001	REG	Subsurface Soil	RIGR	Handgr.	8/18/92	KCP	CPE-27E-1	Boothole	1.4 - 2.2	1																			
30701101	REG	Subsurface Soil	RIGR	Handgr.	8/18/92	KCP	CPE-27E-1	Boothole	2.2 - 2.9	1																			
30701201	OC	Subsurface Soil	DUP	Handgr.	8/18/92	KCP	CPE-27E-1	Boothole	2.2 - 2.9	1																			
30701301	REG	Subsurface Soil	RIGR	Splagon	9/2/92	KCP	CPE-28-1	Boothole	14 - 16	1																			
30701401	REG	Subsurface Soil	RIGR	Splagon	9/2/92	KCP	CPE-28-1	Boothole	22 - 24	1																			
30701501	REG	Subsurface Soil	RIGR	Splagon	9/2/92	KCP	CPE-28-1	Boothole	28 - 30	1																			
REG = Regular						RIGR = Biased Grab						Handgr = Hand Auger																	
QC = Quality Control						Dup = Duplicate						Splagon = Split Spoon																	
AT1:	VOC (TCL) #240																		AT11						Comments				
AT2:	Ca/Be/Ti/P METALS																		AT12:						(1) Not Analyzed (Contaminated during collection see field log book dated 8/19/92, also see section 2.4.2)				
AT3:	HYDROGEN ION (pH)																		AT13:										
AT4:	RADIONUCLIDES																		AT14:										
AT5:	FLUORIDE																		AT15:										
AT6:	Ca/Cr/Fe/Mn/Mo/Ti/P METALS																		AT16:										
AT7:	NITRATE/NITRITE																		AT17:										
AT8:																			AT18:										
AT9:																			AT19:										
AT10:																			AT20:										

Table 2-3. Sample and Analysis Plan Table for OU 3-07

## SAMPLING AND ANALYSIS PLAN TABLE FOR CHEMICAL AND RADIOLOGICAL ANALYSIS

Page 2 of 2  
From No: SAP11A

Project: OUI-7 Summary Report

Project Manager: Carol Mearns

Revision: 0.F

TABLE 2.3

SAP Number:  
Date: 1/15/93

## ENTER ANALYSIS TYPES (AT) AND QUANTITY REQUESTED

SAMPLE DESCRIPTION				SAMPLE LOCATION				ENTER ANALYSIS TYPES (AT) AND QUANTITIES REQUESTED																						
SAMPLE NUMBER	SAMPLE TYPE	MEDIA	COLL. TYPE	SAMPLING METHOD	SAMPLE DATE	AREA	LOCATION	TYPE OF LOCATION	DEPTH (ft)	AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20	
10701601	REG	Subsurface Soil	RIGR	Soilgun	9/2/92	ICPP	CPE-79-1	Borehole	32 - 36 (1)	1	1	1																		
10701701	OC	Subsurface Soil	Dup	Soilgun	9/2/92	ICPP	CPE-79-1	Borehole	32 - 36 (1)	1	1	1																		
10701801	OC	Water	FBLK		8/21/92	ICPP	CPE-26-3	Field Blank	N/A	1																				
10701802	OC	Water	FBLK		8/18/92	ICPP	CPE-37E-1	Field Blank	N/A	1	1																			
10701803	OC	Water	FBLK		9/2/92	ICPP	CPE-79-1	Field Blank	N/A	1	1																			
10701901	OC	Water	FBLK		8/21/92	ICPP	CPE-26-3	Equip. Blank	1.8 - 2.7	1																				
10701902	OC	Water	FBLK		8/18/92	ICPP	CPE-37E-1	Equip. Blank	2.2 - 2.9	1	1																			
10701903	OC	Water	FBLK		9/2/92	ICPP	CPE-79-1	Equip. Blank	N/A	1	1																			
10702001	OC	Water	TBLK		8/19/92	ICPP	CPE-26-7	Top Blank	N/A	1																				
10702002	OC	Water	TBLK		8/18/92	ICPP	CPE-37E-1	Top Blank	N/A	1																				
10702002A	OC	Water	TBLK		8/20/92	ICPP	CPE-26-3	Top Blank	N/A	1																				
10702003	OC	Water	TBLK		9/2/92	ICPP	CPE-79-1	Top Blank	NA	1																				
10702101 (7)	REG	Subsurface Soil	RIGR	Soilgun	9/4/92	ICPP	CPE-79-1	Borehole	41.5 - 42																					
10702201	REG	Subsurface Soil	RIGR	Soilgun	9/4/92	ICPP	CPE-79-1	Borehole	40 - 40.5																					
REG = Regular QC = Quality Control BGR = Biased Grab Dup = Duplicate Hdragr = Hand Auger Spiluge = Split Spoon																														
AT1:	VOC, (TCL) #240										Comments										AT11									
AT2:	C4H6/TC1 P.METALS																				AT12:									
AT3:	HYDROGEN ION (pH)																				AT13:									
AT4:	RADIOCHLORIDES																				AT14:									
AT5:	FLUORIDE																				AT15:									
AT6:	C4H6/HC/IN/IN/TC1 P.METALS																				AT16:									
AT7:	NITRATE/NITRITE																				AT17:									
AT8:																					AT18:									
AT9:																					AT19:									
AT10:																					AT20:									

REG = Regular  
QC = Quality ControlBGR = Blind Grab  
Dup = DuplicatesHandgr = Hand Auger  
Spilgun = Split Spoon

AT1:	VOCs (TCL) B240	AT11		Comments:
AT2:	CHLOR/TCIP METALS	AT12:		(1) Volatile Organic samples collected at 32 and 34 Feet
AT3:	HYDROGEN ION (pH)	AT13:		(2) Not Analyzed due to High Radioactive Activity
AT4:	RADIONUCLIDES	AT14:		
AT5:	FLUORIDE	AT15:		
AT6:	CHLOR/CHLOR/NO/NO/TCIP METALS	AT16:		
AT7:	NITRATE/NITRITE	AT17:		
AT8:		AT18:		
AT9:		AT19:		
AT10:		AT20:		

**Table 2-4. Volatile Organic and Inorganic Compounds and  
the Associated Method Detection Limits (MDL) for Soil Samples**

CAS NO.	COMPOUND	LABORATORY DETECTION LIMIT $\mu\text{g/kg}$	REQUIRED DETECTION LIMIT $\mu\text{g/kg}$
	<u>Volatile Organic Compounds</u>		
74-87-3	Chloromethane	11	50
74-83-9	Bromomethane	11	50
75-01-4	Vinyl chloride	11	50
75-00-3	Chloroethane	11	50
75-09-2	Methylene Chloride	5	25
67-64-1	Acetone	11	50
75-15-0	Carbon Disulfide	5	25
75-35-4	1,1-Dichloroethene	5	25
75-34-3	1,1-Dichloroethane	5	25
540-59-0	1,2-Dichloroethene (total)	5	25
67-66-3	Chloroform	5	25
107-06-2	1,2-Dichloroethane	5	25
78-93-3	2-Butanone	11	50
71-55-6	1,1,1-Trichloroethane	5	25
56-23-5	Carbon Tetrachloride	5	25
108-05-4	Vinyl Acetate	11	50
75-27-4	Bromodichloromethane	5	25
78-87-5	1,2-Dichloropropane	5	25
10061-01-5	cis-1,3-Dichloropropene	5	25
79-01-6	Trichloroethene	5	25
124-48-1	Dibromochloromethane	5	25
79-00-5	1,1,2-Trichloroethane	5	25
71-43-2	Benzene	5	25
10061-02-6	trans-1,3-Dichloropropene	5	25
75-25-2	Bromoform	5	25
108-10-1	4-Methyl-2-pentanone	11	50
591-78-6	2-Hexanone	11	50
127-18-4	Tetrachloroethene	5	25
79-34-5	1,1,2,2-Tetrachloroethane	5	25
108-88-3	Toluene	5	25
108-90-7	Chlorobenzene	5	25
100-41-4	Ethylbenzene	5	25
100-42-5	Styrene	5	25
1330-20-7	Xylene (total)	5	25
	<u>Inorganic Compounds</u>		
7440-47-3	Chromium	N/A	1000
7440-43-9	Cadmium	N/A	1000
7439-96-5	Manganese	N/A	3000
7439-97-6	Mercury	N/A	40
7440-02-0	Nickel	N/A	4000
NA	Nitrate	N/A	N/A
NA	Nitrite	N/A	N/A
16948-48-8	Fluoride	N/A	1000
N/A = Not Available			

For dry soil samples, this computes to the weight of extraction fluid equalling 20x the weight of the waste. Therefore, it is only possible to exceed the TCLP limits if the total metals concentration exceeds the regulatory derived concentration for TCLP by at least a factor 20. This would only occur if 100% of the contaminant leached from the sample

The radiological analyses performed on all soil samples included gamma spectrometry, gross alpha, and gross beta. All detected gamma-emitting isotopes were reported. If the gross alpha activity was greater than 20 pCi/g, individual isotopic analyses for Am-241; Pu-238, -239/240; and U-234, -235, -238 were performed. If the gross beta activity was greater than 30 pCi/g, then isotopic analysis for Sr-90 was performed. The indicator activities of 20 pCi/g alpha and 30 pCi/g beta are based upon normal background activities at the INEL according to D.A. Anderson (EG&G Sample Management Office). These background activities are based upon the radiation levels presented in the report *A Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1990* (DOE/ID-12082(90), June 1991). A complete discussion of these background levels are provided in Section 3.1.1. The selected radionuclides, and the associated MDL, are provided in Table 2-5.

### 2.3.2 Soil Sample Collection and Handling

Hawley Brothers Drilling of Blackfoot, Idaho was contracted by WINCO through MK-FIC to conduct the drilling operations. The on-site activities including sample collection and lithologic logging were performed by Golder Associates, Inc. under supervision from WINCO Environmental Restoration (ER) personnel. The sample preparation for shipping was performed by WINCO ER personnel. All work was conducted in accordance with the Construction Safe Work Permit (CSWP), Hazardous Work Permit (HWP), Radiological Work Permit (RWP), the Radiation Work Control Procedure (RWCP), and the site specific Health and Safety Plan titled *Track 2 Investigation of OU 3-07 Tank Farm and OU 3-08 Tank Farm II*. All personnel working in the exclusion zone were required to read and understand the Health and Safety Plan which was posted in the field site operating base located outside the operable unit. In addition, a daily health and safety meeting was conducted prior to the start of work and documented in the OU 3-07 Field Logbook. Personnel in the exclusion zone were required, at a minimum, to wear safety boots, hard hats, safety glasses, and anti-C clothing in accordance with the Health and Safety Plan.

A WINCO Health Physics Technician (HPT) was on-site to monitor for personnel exposure to radiation, to screen the soil samples for beta-gamma radiation using a hand-held frisker, and to monitor radiation levels from "hot" equipment. In addition, calibrated radiation screening instrumentation were available at all times for self-screening purposes. The soil samples and cuttings were also screened in the field for organic vapors using a Photovac MicroTip®. The results from the field screening are provided in the Borehole Logs (Appendix B).



**Table 2-5. Radionuclides and the Method Detection Limits (MDL)**

<b>ANALYSIS</b>	<b>CONTRACT REQUIRED DETECTION LIMIT (pCi/g)</b>	<b>METHOD DETECTION LIMIT (pCi/g)</b>
Gross Alpha	10	5
Gross Beta	10	6
Strontium 90*	0.5	0.6
Plutonium 238, 239/240	0.05	0.04
Uranium Isotopes	0.05	0.04
Americium 241	0.05	0.05
Thorium 228, 230, 232	0.05	0.04
Gamma Isotopes (based on Cs-137)	1	0.006
Note: *The method detection limit for strontium 90 is greater than the required detection limit. This is probably not significant since strontium 90 was only analyzed when gross beta was > 30 pCi/g.		

The drill rig and downhole tools were decontaminated prior to use following the procedures provided in the *Field Implementation Document*. Prior to the actual drilling operation, the borehole locations were surveyed by WINCO personnel. During the drilling of the borehole, soil samples were collected for chemical and radiological analyses. Samples were collected by using either California split-spoon samplers through the center of hollow-stem augers (site CPP-79) or by using a stainless steel hand auger (sites CPP-26 and CPP-32E). The procedures describing the proper use of this equipment is provided in the *Field Implementation Document* (August 6, 1992). The depth for each sample was measured to the nearest 0.1 feet and recorded in the field logbook.

**2.3.2.1 Hollow Stem Auger Drilling.** The hollow stem augers utilized were 4.25-inch inside diameter (ID) and 8-inch outside diameter (OD). The borehole was advanced from the surface to just above the sample interval with the center bit inside the augers. Once the top of the sample interval was reached, the center bit was removed from the borehole and replaced with a 2-foot long California split-spoon sampler equipped with lexan liners. The sampler was then advanced in the borehole using a rig-mounted hammer driving 140 lbs. at the standard 30 inch drop. The number of blows required to drive the California split-spoon sampler each 6-inch increment was recorded on the Borehole Log by the Project Geologist.

After the California split-spoon sampler was removed from the borehole, it was placed on a clean sheet of plastic on a table within the exclusion zone. The California split-spoon sampler was opened and the open ends of the lexan liners were screened for radioactivity using a hand-held frisker and for organic vapors using a Photovac Microtip®. To ensure consistency in the reading, the instruments were held within 1/2-inch of the sample and the highest readings were recorded on the Borehole Logs.

The selection of the samples for analysis was generally based upon the highest radiation measured in the field. Soil samples for volatile organic analyses were collected first and immediately capped in the field to minimize volatilization. Soil for the remaining analyses were transferred to decontaminated stainless steel bowls and homogenized. All samples were then placed in precleaned and certified sample containers and sealed, labeled, and handled according to the procedures specified in the *Field Implementation Document*.

At a depth of 39 feet bls in borehole CPP-79-1, radioactivity was measured in the drill cuttings at 10,000 counts per minute (cpm) above background and the center bit at 50 mR/hour. Drilling continued at this borehole using Zone 3 Personnel Protective Equipment (PPE), a negative pressure hood, and a constant air monitor (CAM) to the total depth of 41.3 feet bls. All soil samples collected below a depth of 39 feet were measured for beta-gamma radioactivity in the field using a R02A meter and then transported to the ICPP laboratory for processing. Once in the ICPP laboratory, the California split-spoon sampler was opened under an air hood and the sample material transferred to the appropriate container using vinyl gloves. The radioactivity of the soil, as well as the outside of the sample containers, was measured by a WINCO HPT and recorded in the Field Logbook. The samples were then packaged and shipped to the appropriate laboratory in accordance with the procedures described in the *Field Implementation Document* for the shipment of limited quantity radioactive samples.

Once in the ICPP laboratory, the California split-spoon sampler was opened under an air hood. The sample had a contact surface radiation level of  $\approx 400$  mrem/hr beta-gamma. The sample material was then transferred to two 250-ml glass jars using vinyl gloves. One sample jar was filled with the soil collected at a depth from 40 to 40.5 feet bls and one sample jar filled with the soil collected at a depth from 41.5 to 42 feet bls. After the sample was containerized, the 40 to 40.5 foot sample had a surface contact radiation of  $\pm 280$  mrem/hr. This sample jar was then placed inside a DOT Type A canister and had a surface contact radiation measurement of  $< 100$  mrem/hr. The sample was then packaged and labeled in accordance with the requirements for shipping limited quantity samples. Since the radioactivity was above the level allowed for TCT-St. Louis (chemical analysis laboratory), it was only shipped to B&W laboratory for radionuclide analysis. The sample collected from 41.5 to 42 feet bls was disposed back to the borehole since the radiation levels were too high for shipment.

All cuttings brought to the surface via the augers were screened for radioactivity and organic vapors using a hand-held frisker (Ludlum 2A) or Photovac Microtip®, respectively. Since water was not encountered, all cuttings were placed back in the borehole following the completion of the drilling/sampling operation. Any contamination detected in the auger cuttings were backfilled as close as possible to where the contamination originated in the borehole.

**2.3.2.2 Hand Augering Procedures.** A standard 4-inch diameter stainless steel bucket auger was used for the collection of soil samples at sites CPP-26 and CPP-32E. Prior to use, the hand auger was decontaminated in accordance with the procedures described in the *Field Implementation Document*. The auger was advanced in the borehole and the soil brought to the surface was screened for radioactivity. The selection of the appropriate depth to collect the soil sample is based upon the highest measured radiation. Once the sample depth was determined, the soil in the auger was placed in a stainless steel bowl. This soil was then screened for radioactivity using a hand-held frisker and for organic vapors using a Photovac Microtip®. To ensure consistency in the reading, the instruments were held within 1/2-inch of the sample and the highest readings were recorded on the Borehole Logs (Appendix B).

Immediately following the field screening, aliquots of the soil were containerized for volatile organics testing. Soil for the remaining analyses were then thoroughly mixed using a stainless steel spoon. All samples were transferred to precleaned and certified sample containers, which were sealed, labeled, and handled according to the procedures specified in the *Field Implementation Document*. All samples were packaged and preserved following the recommended guidelines in the *Field Implementation Document*. Chain-of-custody, shipping, and documentation procedures were also followed as described in the *Field Implementation Document*.

**2.3.2.3 Decontamination Procedures.** All sampling equipment and small hand-held tools were decontaminated using deionized water, nonphosphate detergent, pesticide grade methanol, and ASTM Type II purity water as described in the *Field Implementation Document*. If the sampling equipment was not used immediately, it was wrapped in plastic and aluminum foil to prevent possible contamination. The drilling rig and all downhole drilling and sampling equipment were steam cleaned

upon arrival to the ICPP, between soil borings, and before leaving the site. If the equipment was not used immediately, it was wrapped with plastic sheeting and placed on pallets to prevent contamination.

If radioactivity was encountered during the drilling operation, all downhole equipment was decontaminated while being pulled from the borehole using glass cleaner and distilled water. Following this initial decontamination, the potentially contaminated equipment was double-bagged and taken from the control zone to the WINCO decontamination facility for further cleaning. Following decontamination of the equipment, smears were taken by WINCO HPT to test for residual radioactivity. The decontamination procedure continued until the HPT released the equipment from the decontamination shop. The back of the drill rig, the controls, and other miscellaneous equipment were also smeared and counted before moving out of the radiation control zone.

All waste decontamination fluids were collected and containerized on-site. These fluids were later disposed through the PEW evaporator.

**2.3.2.4 Field Documentation.** All information pertaining to the Track 2 investigation at OU 3-07 is described in the bound logbook titled *Environmental Restoration Operable Unit 3-07 Field Logbook*. This logbook is divided into various sections including the Field Activity Daily Log, Borehole Log, Sample Collection Log, Location Map, Photo Log, Visitor Log, and Safety Briefing Log. The requirements for proper documentation are described in detail in WINCO Project Directive 1.18 - ERP Field Site Logkeeping Requirements. This logbook provides a complete description of all field activities pertaining to OU 3-07 and is located in the project files.

### **2.3.3 Ground Water Sampling**

In September and October 1992, ground water samples were collected from wells 55-06, TF-2, TF-3, and 37-4 that monitor the perched water created by the 110 foot interbed and the lysimeters TF-1, TF-2, TF-3, and TF-5 in the vicinity of the tank farm (Table 2-6). These water samples were collected in accordance with the procedures described in the *Ground Water Field Sampling Plan for the Idaho Chemical Processing Plant* (J. Lyle [DOE-ID] letter dated April 24, 1992 to W. Pierre [EPA Region-X] and D. Nygard [IDHW]).

**2.3.3.1 Water Level Measurements.** Prior to sample collection, water levels measurements were taken in the well to determine the piezometric head of the aquifer. This information was then used to calculate the volume of water necessary to evacuate prior to sample collection. The measurements were taken by using an electric water level sounder following the procedures described in the *Ground Water Field Sampling Plan*. The depth to water was measured from a surveyed reference marker and recorded on the ground water sampling form to the nearest 0.01 foot.

**2.3.3.2 Ground Water Sampling Procedures.** This section provides a brief summary of the important aspects of the ground water sampling. For a complete description of the procedures and the sampling operation, the reader is referred to the *Ground Water Field Sampling Plan* and the Ground Water Sampling Logbook, respectively.

Table 2-6. Ground Water Samples Collected from the Tank Farm Wells and Lysimeters

Well/ Lysimeter	Date Sampled	Comments
55-06 (well)	September 30, 1992	No turbidity or conductivity measurements taken on the water samples.
TF-1 (well)	Not Sampled	Dry. (Base of screen set at 99'. Does not appear to penetrate water bearing zone).
TF-2 (well)	September 17, 1992	Did not collect non-RCRA metals due to compressor air line failure. In addition, only 1/2 of the metal sample was filtered in the field due to the compressor failure.
TF-3 (well)	September 23, 1992	No turbidity measurements taken on the water sample.
TF-4 (deep well)	Not Sampled	15 feet of water in well. Pump not operating correctly to collect a sample.
TF-4 (shallow well)	Not Sampled	Dry.
TF-1 (lysimeter)	November 4, 1992	Pressure rose quickly; Sample immediately; 100 ml of water recovered.
TF-2 (lysimeter)	November 4, 1992	No water produced; Lysimeter lost suction; Not sampled.
TF-3 (lysimeter)	November 6, 1992 November 8, 1992	70 ml of water recovered on November 6. 20 ml of water recovered on November 8.
TF-5 (shallow lysimeter)	November 4, 1992	20-50 ml of water recovered on November 4.
TF-5 (deep lysimeter)	November 4, 1992	Lysimeter not functioning.

All wells were purged prior to sampling collection. Purging was performed by using the dedicated stainless steel Hydrostar piston pumps. All purge water evacuated from the well was containerized and disposed through the PEW evaporator.

During the purge operation, a Hydrolab® instrument was used to measure the pH, temperature, specific conductance (SC), and the dissolved oxygen content of the water. After three wellbore volumes were evacuated, and when three consecutive measurements of the water were within the limits listed below, water quality samples were collected.

pH:	±0.1 standard units
temperature:	±0.5 degrees centigrade
specific conductance:	±µmhos/cm
color:	no visually discernible difference

If the parameters did not stabilize after the evacuation of three wellbore volumes, ground water samples were collected and the appropriate notations were recorded in the sampling logbooks.

The water samples were collected from wells 55-06, TF-2, and TF-3 using a dedicated Hydrostar piston pump. The typical aqueous sample requirements including the container type, preservative, holding time, and sample volume are described in the *Ground Water Field Sampling Plan*. Sample bottles for liquid inorganic and radionuclide analyses were filled to approximately 90% of capacity to allow for expansion. Sample bottles for semi-volatile/pesticide/PCB analyses were filled to capacity with minimal headspace. The 40-ml glass vials collected for volatile analyses were filled with no headspace or visible air bubbles. Immediately upon collection, all sample containers were cooled to 4°C.

Unless otherwise specified in Table 2-6, the ground water samples were analyzed for the RCRA Ground Water Contamination Parameters (pH, specific conductance, total organic halogen, and total organic carbon), the RCRA Ground Water Quality Parameters (barium, cadmium, chromium, silver, arsenic, lead, selenium, mercury, fluoride, nitrate, endrin, lindane, methoxychlor, toxaphene, 2,4-D, silvex, gross alpha, and gross beta), miscellaneous parameters (calcium, magnesium, potassium, zirconium, bicarbonate, carbonate, and nitrate), and radionuclides (Sb-125, Cs-137, Co-60, I-129, Sr-90, and tritium). The data validation for these analyses is provided in Section 2.4 with the results being discussed in Section 5.

## 2.4 Quality Assurance/Quality Control

Quality Assurance/Quality Control requirements for the Track 2 investigation of soil contamination at OU 3-07 were specified in the QAPjP (*Quality Assurance Project Plan for & Characterization Activities at WAG 3 July 21, 1992*). This QAPjP is part of the complete SAP directing field activities that also includes a Field Sampling Plan (FSP) and a Health and Safety Plan (HSP).

The current quality report focuses on issues related to both soil contamination at the tank farm OU 3-07, and ground water contamination of the perched ground water created by the "110 ft interbed" near the tank farm. The

Form 1 analytical data and the complete validation forms are available in the project files.

#### 2.4.1 Changes to the Sampling and Analysis Plan

There were no substantive differences between the soil sampling procedures outlined in the SAP and those implemented in the field. Table 2-2 summarizes the non-quantitative DQOs which directed the sampling event, and the activities required to meet the DQOs. All activities were completed as planned except:

- The original location for borehole CPP-26-3 encountered auger refusal at a depth of 1.1 feet bls and had to be relocated. The second borehole was then only drilled to a depth of 4 feet rather than the anticipated 6 feet due to the presence of a concrete obstruction.
- The objective to reoccupy the existing buried "observation wells" at CPP-28 was unsuccessful. Since the excavation in the area failed to locate these "observation wells", it was concluded that either 1) they have been removed from the site or 2) the excavation was in the wrong area.
- The original objective for the borehole at CPP-79 was to drill to a depth of 25 feet or below any contamination encountered. Since contamination was not detected in the field to a depth of 25 feet based on radiation measurements, it was decided to extend to borehole to the top of basalt. As a result, this borehole encountered an unexpected zone of high radiation at 39 feet bls and was not able to fully define the bottom extent of contamination due to health and safety concerns.

#### 2.4.2 Documentation Review of the Field Sampling

An independent review of the documentation was performed to evaluate the potential impact of any problems which may have occurred in the field that could affect the sample analytical results. The field logbook and chain-of-custody forms were reviewed to identify potential problems.

Table 2-3 shows the soil samples and associated quality control samples collected during the field investigation of OU 3-07. Two samples were collected from each of three boreholes at site CPP-26. These samples were analyzed for volatiles, pH, radionuclides, fluoride, nitrate/nitrite, and metals. The only problems discovered during a cross-check between the Sample Collection Log and the Chain-of-Custody (COC) records were:

- The depth from which sample 30700401 was collected is listed as 4.0-4.7 in the Sample Collection Log and as 4.0-4.6 in most places on the COC form. This is a minor inconsistency and the depth from the Sample Collection Log was used.
- Sample 30700301 was not analyzed for fluoride and metals because the sample was contaminated during collection. The field logbook notes that water from melting ice contaminated the sample.

- The trip blank associated with the samples is reported as 30702001 on the COC forms, but this sample is not mentioned in the Sample Collection Log. Sample 30702001 does appear to have been submitted with samples from this site and the COC forms appear to be correct.
- A second trip blank was apparently submitted with samples from the site and listed on COC records as sample 30702002AVL. This was not documented in the Sample Collection Log and sample number 30702002VL was also used for another sample. The date of submittal appears to be sufficient to differentiate between these two samples.

The number of soil samples collected and successfully analyzed for site CPP-26 were sufficient to meet the sample requirements stated in the sampling and analysis plan and summarized in Table 2-2.

Two samples were collected from a single borehole at CPP-32E. These samples were analyzed for volatile organic compounds, metals, pH, and radionuclides. There were no problems with the field collection or chain-of-custody except for the designation of the trip blank as sample 30702002. This number is the same number assigned to the trip blank for CPP-26 in the sample collection log. The trip blank for site CPP-26 appears to have been sample 30702001. The date of collection is sufficient to determine the actual sample. The number of samples collected and successfully analyzed from CPP-32E were sufficient to meet the sample requirements stated in the sampling and analysis plan and summarized in Table 2-2.

Five samples were collected from a single borehole at site CPP-79. Four of these samples were analyzed for volatile organic compounds, metals, pH, radionuclides, and nitrate/nitrite. Two additional samples were collected from the bottom of the borehole (30702201 from 40-40.5 ft bls; and 30702101 from 41.5-42.0). The two deepest samples showed high levels of gamma and beta radiation and were too radioactive for any analysis other than radionuclides. Only sample 30702201 was analyzed for radionuclides. The number of samples collected and successfully analyzed from CPP-79 were sufficient to meet the sample requirements stated in the sampling and analysis plan and summarized in Table 2-2.

There were no problems with the Sample Collection Log or the COC forms except for sample 30701301VL and sample 30702101RN. Neither of these samples were recorded on the COC form. For validation purposes, these samples were tracked via their collection date.

#### 2.4.3 Summary of Soil Analyses Validation

Limitation and Validation (L&V) Reports were prepared by the Sample Management Office of EG&G Idaho, Inc. for the assessment of the laboratory quality control on the following analyses:

- metals by ICP and AA;
- volatile organic compounds;
- nitrate/nitrite
- fluoride; and
- radionuclides.



The L&V reports were prepared to meet the requirements of validation level A (SMO-SOP-12.1.1) which is the most stringent validation level and requires a complete review of all new data. In addition, a 100% check of the critical samples were performed. The identification of the project's critical samples are provided in Table 2-2. Non-critical samples were validated by association with the critical samples. The L&V reports were formally transmitted to the EPA and IDHW in accordance with the 120 day reporting schedule specified in Section XIX of the FFA/CO.

The L&V reports only evaluate the laboratory QA/QC and do not include an evaluation of the associated sample blanks. Table 2-7 shows the compounds detected in the field blanks, equipment rinsate blanks, and trip blanks. Only volatile organic compounds (Methylene Chloride, Acetone, 2-Butanone, and 2-Hexanone) were detected in any of the sample blanks. The results from these blanks were then used to qualify samples from their respective sample batches.

The only volatile organic compound detected (after blank contamination was accounted for) was toluene which was detected in scattered samples. All of the toluene detections were flagged as estimated (J) since they were detected at concentrations below the Method Detection Limit. The nitrate/nitrite determinations were flagged as (J) because of problems with the individual determination of nitrate and nitrite. This does not affect the useability of the combined nitrate and nitrite concentration. Fluoride was also flagged as J (UJ) because of possible matrix interferences with the analytical method used and questions about the independence of the Independent Calibration Standard.

Radionuclide analyses for the Track 2 investigation of OU 3-07 were reported in two sample delivery groups, SDG 30700101RN and SDG 30701101RN. These SDGs were included in a single L&V report from the EG&G SMO (DAA-07-92). The L&V report states that one detector was not adequately calibrated and the associated values were qualified as estimates (J). Some of the duplicate results for gross alpha Sr-90 and Pu-238 in SDG 30700101RN were out of control and the associated samples were qualified as estimates (J).

A subsequent internal review by WINCO showed that the chemical yield for U-238, U-235, U-234, Pu-239, and Pu-238 in sample 30702201RN was 0%. The associated data were assigned "R" qualifiers as unuseable. The review also showed that the yield of Am-241 in sample 30702201RN was 19.1%, and this value was assigned a "J" qualifier.

There were no other major problems with the radiochemical data.

**Table 2-7. Compounds Detected in Sample Blanks Associated with Soil Samples**

Sample Numbers	Site	Type of Blank	Methylene Chloride ( $\mu\text{g/l}$ )	Acetone ( $\mu\text{g/l}$ )	2-Butanone ( $\mu\text{g/l}$ )	2-Hexanone ( $\mu\text{g/l}$ )
30701801__	CPP26	field	--	49	7	--
30701802__	CPP32E	field	--	18	10	--
30701803__	CPP79	field	--	19	--	--
30701901__	CPP26	equip.	--	35	--	--
30701902__	CPP32E	equip.	--	46	--	--
30701903__	CPP79	equip.	3J	120	--	6J
30702001__	CPP26	trip	2J	--	--	--
30702002__	CPP32E	trip	2J	--	--	--
30702002A__	CPP26	trip	2J	--	--	--
30702003__	CPP79	trip	--	16	--	--
<p>J - Indicates an estimated concentration where the value reported is less than the contractual sample detection limit, but greater than the instrument detection limit.</p>						

2.4.3.1 Quantitative DQOS PARCC Parameters The project goals for precision, accuracy, and completeness according to the final Method Selection Worksheets are shown in Table 2-8.

#### Precision

The *Quality Assurance Project Plan for WAG 3* (July 21, 1992) defines precision as RPD or RSD (equation 1 and 2, respectively).

$$RPD = \frac{(C_1 - C_2)}{(C_1 + C_2)/2} \quad (2)$$

where RPD = relative percent difference  
 $C_1$  = larger of the two measurements (or larger of MS/MSD values)  
 $C_2$  = smaller of the two measurements (or smaller of MS/MSD values)

$$RSD = \left( \frac{s}{\bar{y}} \right) * 100\% \quad (3)$$

where RSD = relative standard deviation  
 $s$  = standard deviation  
 $\bar{y}$  = mean of duplicate analyses

The standard deviation in equation 2 is defined as:

$$\sum_{i=1}^n \sqrt{\frac{(y_i - \bar{y})^2}{n-1}} \quad (4)$$

where  $s$  = standard deviation  
 $y_i$  = measured value of the  $i$ th duplicate  
 $\bar{y}$  = mean of duplicate measurements  
 $n$  = number of duplicates

Table 2-9 shows percent RPD values for the compounds detected in the field duplicates collected during the course of the investigation. Percent RPD values are in excess of the goals for precision established for manganese in the duplicate samples from CPP-26-2, for mercury in the duplicate samples from CPP-31-1, and for nitrate in duplication samples from CPP-26-3 and CPP-79-1. Percent RPD goals were not established for radionuclides.

Soil samples are inherently heterogeneous and these high RPD values may be the result of unavoidable sample variability rather than indicating problems with the analytical QA/QC.

**Table 2-8. PARCC Goals for OU 3-07 from the  
Final Method Selection Worksheets**

<b>Parameter</b>	<b>Precision</b>	<b>Accuracy</b>
Metals	± 20%	75-125%
pH	± 20%	75-125%
TOC	± 20%	75-125%
Nitrate	± 20%	75-125%
Nitrite	± 20%	75-125%
Fluoride	± 20%	75-125%
Radiochemical	N/A	N/A
<b>Completeness (Project) - 90% for non-critical samples; 100% for critical samples (where specified)</b>		

**Table 2-9. Relative Percent Difference (RPD) for the Soil Samples**

Borehole	Depth (ft. b/s)	Sample #	Toluene	Acetone	Meth. Chloride	Chromium	Manganese	Mercury	Nickel	pH	Nitrate	Nitrite	Fluoride
CPP-26-1	5.5-6.0	30700201 30700301	0.00	0.00	0.00	(1)	(1)	(1)	(1)	2.92	16.00	0.00	(1)
CPP-26-2	4.0-4.7	30700401 30700601	0.00	0.00	0.00	2.84	44.94	6.45	6.95	0.97	0.00	0.00	3.10
CPP-26-3	1.8-2.7	30700801 30700901	0.00	9.52	0.00	5.98	20.37	18.18	5.84	1.98	82.05	0.00	10.41
CPP-32E-1	2.2-2.9	30701101 30701201	0.00	0.00	0.00	(2)	(2)	60.87	(2)	1.07	(2)	(2)	(2)
CPP-79-1	32-36	30701601 30701701	0.00	5.00	0.00	(2)	(2)	0.00	(2)	1.30	40.00	0.00	(2)
NOTE: All values are % RPD.													
(1) Duplicate sample contaminated during shipment and not analyzed.													
(2) Samples not analyzed for these constituents.													

## Accuracy

The accuracy of analyses is measured by the recovery of compounds (%R) from matrix spike and matrix spike duplicates and is given by the following equation:

$$\%R = 100\% \times \frac{S-U}{C_{sa}} \quad (5)$$

where      %R      =      percent recovery  
             S        =      measured concentration in spiked aliquot  
             U        =      measured concentration in unspiked aliquot  
             C<sub>sa</sub>      =      actual concentration of spike added

The project L&V show that all Matrix Spike and Matrix Spike Duplicate results were within limits for all samples except for ICP and AA analyses of Sample Delivery Group (SDG) 30700101MP. For this SDG, the recovery of manganese from the matrix spike duplicate sample was 146%. This is outside the accuracy goals. Both manganese and nickel also had %RPD values outside established limits (38% and 57% respectively). The values for these analytes in this SDG were qualified with J qualifiers.

## Completeness

Completeness is defined as %completeness and is given by the following equation:

$$\%C = \frac{V}{n} * 100\% \quad (6)$$

where %C      =      percent completeness  
             V        =      number of valid measurements  
             n        =      number of measurements specified in the sampling and analysis plan

Table 2-10 lists the samples specified in the SAP and samples actually collected. The percent completeness was 100% for both critical and non-critical samples and is well within the goals established in the SAP.

Table 2-10. Results of Sample Completeness for OU 3-07

Location	Samples Specified in SAP	Borehole	Samples Collected	Sample Depth (feet-bls)	Successfully Analyzed	Completeness
CPP-26	Collect two soil samples from each boring. Sample intervals will correspond to the highest field radiation readings. The most radioactive sample will be the critical sample. One duplicate sample per contaminated zone will be collected per borehole.	CPP26-1	30700101*	3.8-4.7'	Yes	100%
			30700201	5.5-6.0'	Yes	
			30700301**	5.5-6.0'	Yes	
		CPP26-2	30700401	4.0-4.7'	Yes	100%
			30700501*	5.7-6.1'	Yes	
			30700601**	4.0-4.7'	Yes	
CPP-32E	Collect two soil samples from each boring. Sample intervals will correspond to the highest field radiation readings. The most radioactive sample will be the critical sample. One duplicate sample per contaminated zone will be collected per borehole.	CPP26-3	30700701	1.0-1.8'	Yes	100%
			30700801*	1.8-2.7'	Yes	
			30700901**	1.8-2.7'	Yes	
		CPP32E-1	30701001	1.4-2.3'	Yes	100%
			30701101*	2.2-2.9'	Yes	
			30701201**	2.2-2.9'	Yes	

Table 2-10. Results of Sample Completeness for OU 3-07

Location	Samples Specified in SAP	Borehole	Samples Collected	Sample Depth (feet-bls)	Successfully Analyzed	Completeness
CPP-79	Continuous sampling after the zone of contamination is encountered. If the zone of contamination is greater than 10 feet thick, submit 4 samples for analysis (2 samples bracketing the zone and 2 samples from the zone). The most radioactive and deepest samples are critical. One duplicate sample per contaminated zone will be collected.	CPP79-1	3071301 30701401* 30701501 30701601 30701701** 30702101 (1) 30702201* (2)	14-16' 22-24' 28-30' 32-36' 32-36' 41.5-42' 40-40.5'	Yes Yes Yes Yes Yes No Yes	100%
Quality	One per sample cooler containing VOC samples	Trip Blanks	30702001 30702002 30702002A 30702003		Yes Yes Yes Yes	100%
Quality	One per sampling day per sampling method used.	Equipment Rinsate Blanks	307019001 307019002 307019003		Yes Yes Yes	100%
Quality	One per analysis batch or every 20 samples	Field Blanks	307018001 307018002 307018003		Yes Yes Yes	100%
* Designates critical samples based on the highest measured beta-gamma radiation.						
** Designates duplicate samples						
(1) Sample too "hot" for chemical analyses.						
(2) Only analyzed for radionuclides; sample too "hot" for chemical analyses.						



#### 2.4.4 Overall Assessment of Data Quality for Soil Samples

The overall quality of the data is good. Field blanks, rinsate blanks, and trip blanks were contaminated with common lab contaminants, but this does not have any significant effect on the overall data quality. There were no major problems with either the metals or the radionuclide determinations, although some of the radiochemical parameters did receive qualifiers.

The holding times for all samples were met except for nitrate/nitrite. Nitrate/nitrite analyses should be re-analyzed within the proper holding times if differentiation between nitrate/nitrite is crucial. The total concentration of nitrate/nitrite is the quantity of interest in this investigation, and the (J) flags do not affect this determination. Therefore, this missed holding times do not effect the overall data quality.

The fluoride analyses were performed by ion chromatography. They were flagged (J) by the data reviewers because of concern about possible matrix interferences and questions about the independence of the independent verification standard used. Ion chromatography was recommended by chemists at the Sample Management Office of EG&G Idaho, Inc. familiar with matrix effects at this site. The method, therefore, should not be subject to significant matrix interferences. The independent verification standard in question was from a different lot number than the initial standards, but from the same manufacturer. There is no formal requirement for this degree of independence. Neither of these problems seem likely to have any major effect on the data, but the qualifiers were allowed to stand.

#### 2.4.5 Changes to the Ground Water Sampling and Analysis Plan

Substantive differences between the ground water and lysimeter sampling procedures outlined in the Sampling and Analysis Plan (SAP) and those implemented in the field included:

- samples for metals analysis were not filtered prior to preservation with nitric acid. The values for metals determined during this sampling round, therefore, reflect total metals (including those present in clays and other particulates) and not metals in solution.
- samples for radioactive cations (Sr-90 and Cs-137) were not filtered prior to preservation with nitric acid. These values, therefore, may not represent the amounts of these constituents in solution.

The non-quantitative DQOs which directed the sampling specified one additional round of data from the tank farm wells, well 55-06, and the Tank Farm lysimeters. The activities were completed as planned except:

- Well TF-1 was not sampled because it does not penetrate the perched water bearing zone and was dry;
- Only the deep well at location 33-4 was sampled. The shallow well does not penetrate the perched water zone and was dry;
- No sample was obtained from lysimeter TF-2. This lysimeter lost its vacuum before sampling and may be broken;
- No sample was obtained from lysimeter TF-5-deep. The lysimeter appears to be broken; and

- The water produced from the three lysimeters which were sampled (lysimeters TF-1, TF-3, and TF-5 shallow) was small. The volume of sample obtained was only sufficient to allow the determination of gamma isotopes.

#### 2.4.6 Review of Field Documentation for Water Sampling

An independent review of the documentation was performed to determine if there were any occurrences in the field which might impact the overall quality of the data (Appendix E) or which might need to be considered while the data is interpreted. The field logbook and chain-of-custody forms were reviewed to identify potential problems.

The major concerns identified during the field validation of the ground water data were related to the preservation of samples. The field notes state that the ground water samples collected for metals analysis and designated 3GW00201 and 3GW01401 were not filtered prior to preservation with nitric acid. The metals values determined for these samples, therefore, are for total metals in the sample and are not for metals in solution.

The Ground Water Monitoring Plan also specifies that samples to be used for the determination of radioactive cations (such as Sr-90 and Cs-137) be filtered prior to preservation. The ground water samples collected for the analysis of these parameters during the third quarter sampling event were not filter prior to preservation. These results should be viewed as total contaminants and not as an indication of the quantities of contaminants in solution.

A number of other minor problems were identified during the field validation:

- Samples for the analysis of total nitrate plus nitrite were preserved at 4°C but were not acidified with sulfuric acid. The holding time for this analysis if samples are preserved with sulfuric acid is 28 days. If the samples are not acidified the holding time for nitrate and nitrite is 48 hours (EPA, 1983).
- Custody seals numbers are not documented on COC records and shipping information is not documented for some shipments as required by WINCO procedures.
- Notes on COC records state the several shipments arrived at the analytical laboratory with a temperature of 8°C. This is slightly higher than the 4±2°C specified for preservation.
- The source, cleanliness, an lot number of containers is not overtly mentioned in the field log.

None of these problems has any major effect on the useability of the data.

#### 2.4.7 Summary of Method Validation of Ground Water Samples

Limitation and Validation (L and V) Reports were prepared by the Sample Management Office of EG&G Idaho, Inc. for the assessment of the laboratory quality control on the following analyses:

- pH and SC;
- TOX and TOC;

- barium, chromium, lead, mercury, iron, sodium, calcium, and magnesium, by ICP or AA;
- nitrate plus nitrite, fluoride, chloride, and sulfate;
- alkalinity, carbonate, bicarbonate;
- radionuclides.

The L and V reports were prepared to meet the requirements of validation level A (SMO-SOP-12.1.1) which is the most stringent validation level and requires a complete review of the data. The L and V reports were formally transmitted to the EPA and the IDHW in accordance with the 120 day reporting schedule.

The L and V reports only evaluated the laboratory QA/QC and do not evaluate the associated sample blanks. Table 2-11 shows the ground water samples collected during the field investigation of OU3-07. There were no field blanks or duplicates collected during tank farm sampling, but a field blank and duplicate were collected at well PW-4 during the third quarter sampling, and these quality control samples control this data. Table 2-12 shows the compounds detected in the field blank (sample 3GW02701). The detections in the blanks are used to qualify the associated data by multiplying the value detected by a factor of 5 and assigning "U" qualifiers to all associated data.

#### 2.4.7.1 Quantitative DQOs PARCC Parameters

The project goals for precision, accuracy, and completeness according to the final Method Selection Worksheets are shown in Table 2-13.

##### Precision

The Quality Assurance Project Plan for WAG 3 (July 21, 1992) defines precision as shown in section 2.4.3.1. Field duplicates were not collected from any of the tank farm wells sampled during Table 2-14 shows the compounds detected in sample 3GW01101 and in its duplicated 3GW02601 together with relative percent difference values calculated from these results. Relative percent differences were above the goals for cadmium, total organic halide (TOX), magnesium and potassium. The exceedance for potassium was minor (22% RPD versus and goal of 20%); for cadmium and magnesium the exceedances are caused by the detected value being slightly above the detection limit for one sample and under the detection limit for the other. The RPD values for potassium, cadmium, and magnesium do not appear to reflect any inherent problems with these analyses. The RPD for TOX is quite high and is for detections in both samples. This suggests that there may be problems with the determination of TOX, at least at the part per billion level.

##### Accuracy

The accuracy of analyses is measured by the recovery of compounds (%R) from matrix spike and matrix spike duplicates. The equation for %R is given in section 2.4.3.1.

The project L and V reports show that Matrix Spike and Matrix Spike Duplicate results were within limits for all samples except for endrin in SDG 3GW00501W4 which were 128 and 132%. The %RPD for MS/MSD results in SDG 3GW00501W4 was also high (51%) and could indicate problems with accuracy.

MS/MSD results are not measured in the analysis of radioactive components, but intercomparison samples are analyzed for gross-alpha, gross-beta, Sr-90, and H-3 by Barringer laboratories as part of the EPA intercomparison study. Values reported by the laboratory were within acceptable limits.

### Completeness

Completeness is defined as % completeness using the equation presented in section 2.4.3.1. Table 2-11 lists the samples specified in the SAP and the samples actually collected. The percent completeness goal was 100% for critical samples. This was not obtained because well TF-1 and TF-4 shallow were dry, the pump in well TF-4 deep was not working properly, and the lysimeters did not produce sufficient water for all analyses.

**Table 2-11**  
**Ground Water Samples Collected During the Field Investigation**

Location	Samples specified in SAP	Well or Lysimeter	Sample Number	Successfully Analyzed	Completeness Total
Tank Farm Wells		33-2	3GW01401	pH, Sc, TOX, TOC, RCRA Metals, Fe, Mn, Na, fluoride, nitrate + nitrite, chlorinated pesticides, chlorinated herbicides, chloride, sulfate, bromide, alkalinity, gross $\alpha$ & $\beta$ , $\gamma$ -isotopes, Sr-90, I-129, H-3	100%
		33-3	3GW01501	pH, Sc, TOX, TOC, RCRA Metals, Fe, Mn, Na, fluoride, nitrate + nitrite, chlorinated pesticides, chlorinated herbicides, chloride, sulfate, bromide, alkalinity, gross $\alpha$ & $\beta$ , $\gamma$ -isotopes, Sr-90, I-129, H-3	100%
Tank Farm Lysimeters		33-1L	3GW01901	$\gamma$ -isotopes, Sr-90, and I-129	15%●
		33-3L	3GW02201	$\gamma$ -isotopes, Sr-90, and I-129	15%*
		33-5L	3GW02301	$\gamma$ -isotopes, Sr-90, and I-129	15%*

Location	Samples specified in SAP	Well or Lysimeter	Sample Number	Successfully Analyzed	Completeness Total
55-06		55-06	3GW01801	pH, Sc, TOX, TOC, RCRA Metals, Fe, Mn, Na, fluoride, nitrate + nitrite, chlorinated pesticides, chlorinated herbicides, gross $\alpha$ & $\beta$ , chloride, sulfate, bromide, alkalinity, $\gamma$ -isotopes, Sr-90, I-129, H-3	100%

Note: \* low percent completeness is due to the small volume of water recovered from the lysimeters. This an inherent property of lysimeters beyond the control of the sampling personnel.

**Table 2-12**  
**Compounds Detected in Field Blank (3GW02701)**

COMPOUND	AMOUNT DETECTED ( $\mu\text{g/L}$ )	DETECTION LIMIT FOR COMPOUND ( $\mu\text{g/L}$ )*
Chromium	10	50
Iron	739	3,695
Fluoride	184	920
Nitrate	410	2,050
Chloride	5,690	28,450
Sulfate	27,800	139,000
TOC	4,410	22,050

Note: \* the effective detection limit for compounds detected in blank samples is 5 times the highest detection in the blank sample. Detections of less than this amount are qualified "U" during data validation.

**Table 2-13. PARCC Goals for Ground Water Samples for OU3-07 from the  
Final Method Selection Worksheets**

<b>Parameter</b>	<b>Precision (RPD)</b>	<b>Accuracy %R</b>
Metals	±20	75-125
pH, Sc	±20	NA
TOC, TOX	±20	75-125
Endrin	±25	56-121
Lindane	±25	56-123
Toxaphene	±25	41-126
Herbicides	±30	40-125
Anions	±20	75-125
Completeness (Project) - 100%		



**Table 2-14. Compounds Detected in Samples 3GW01101 and 3GW02601**

COMPOUND	3GW01101	3GW02601	RPD
Barium	234	242	3
Cadmium	5	5U	200
Sodium	169,000	170,000	1
Chloride	283,000	299,000	5
TOX	45.4	14.7	102
Alkalinity	na	157,000	—
Calcium	73,000	70,600	3
Magnesium	20,600U	20,000	64
Potassium	5,050	6,310	22

Note: na = not analyzed; U = not detected.

### 3.0 SUMMARY OF THE RISK ASSESSMENT METHODOLOGY

The risk assessment methodology as described in *Track 2 Sites: Guidance for Assessing Low Probability Hazard Sites at the INEL* (DOE/ID-10389, Revision 3) and *Risk Assessment Guidance for Superfund, Volume 1 Human Health Evaluation Manual (Part A)* (EPA/540/1-89/002, Interim Final) was used to characterize the probability of adverse effects on human health from potential exposures to hazardous and radioactive constituents present at each site at this operable unit. The following is a discussion of this assessment, which addresses only adverse effects on human health and does not address either ecological or environmental effects.

This risk assessment first involves the identification of potential contaminants of concern, the concentrations of these compounds in the affected environmental media, the potential exposure pathways, and the exposed or potentially exposed human receptors. The second portion of the risk assessment then involves the calculation of risks from the estimated or measured concentrations of contaminants and/or risk-based concentrations based on either a hazard quotient of 1 for non-carcinogenic contaminants, or a risk in the range of  $10^{-4}$  to  $10^{-6}$  for carcinogenic contaminants. The health and environmental criteria used to compare the measured or predicted contaminant concentrations or to estimate risk are based on EPA established carcinogenic and non-carcinogenic chronic exposure limits as documented in the Integrated Risk Information System (IRIS) or the Health Effects Assessment Summary Tables (HEAST) (EPA 1992b).

The risk assessment methodology and corresponding exposure parameters used are described in the Track 2 Guidance Document (DOE/ID-10389, Revision 3), and summarized in the following sections. The identification of contaminants, exposure pathways, and contaminant physical parameters are discussed in Section 3.1. Sections 3.2 and 3.3 summarize the rationale and equations used in the toxicity and exposure assessments, respectively.

#### 3.1 Contaminants/Parameters of Potential Concern

To identify the contaminants of potential concern, it is first necessary to identify the relevant chemicals or radionuclides for each site, determine their toxicity, tabulate the physical and chemical properties that influence or determine their environmental fate, and quantify their concentrations at the site in the media of concern. Historical documents, process information and sampling data were used to identify a preliminary list of potential contaminants for each site.

The Track 2 investigation at OU 3-07 involved releases related to the HLLWTF. This facility provides interim storage for what commonly is referred to as first, second, and third cycle solutions. The majority of these solutions originate from the reprocessing of spent nuclear fuels. The process consists of dissolving the fuel in concentrated nitric or mixed nitric and hydrofluoric acid baths, to produce a solution of uranyl nitrate suitable for solvent extraction. The solvent extraction reprocessing separates recoverable quantities of U-235 from cladding material, fission products, etc. The resulting waste solutions are then typically stored in the HLLWTF until they are scheduled to be calcined, or processed in the PEW Evaporator.

Based upon the composition of the waste stream, a preliminary list of potential contaminants that may be present at a release site within OU 3-07 are provided in Table 3-1 (WINCO, 1989). This list of potential contaminants only includes the possible inorganic compounds and radionuclides, and does not include any organic compounds that may be present. According to a conversation with K.L. Shifty (WINCO, 1992d), the organic compounds that may be present in the waste stream at concentrations of concern include tetrachloroethylene; 1,1,1-trichloroethane; 1,1,2-trichloroethane; and trichloroethylene.

The constituents in the high level liquid waste were then evaluated to determine the contaminants of potential concern for the Track 2 investigation. This evaluation was based on a variety of factors including process knowledge of the typical contaminant concentrations in the HLLW, the contaminant half-life, the specific activity, and the contaminant retardation factor ( $K_d$ ). The results from this evaluation are provided in a letter (*WASTREN Remediation* 1992) and is included in Appendix C. The contaminants of potential concern identified during this effort were included in the Method Selection Worksheets of the SAP for sites CPP-26, CPP-32E, and CPP-79.

These Method Selection Worksheets were then transmitted to the EG&G SMO to subcontract the analytical laboratory through the existing task order contracts. Using the existing laboratories under contract to the SMO, it was not possible to analyze the soil samples for I-129, Tc-99, and Np-237 since these analyses were not specified in the existing task order agreement. Given the time constraints of the up-coming field investigation, it was also not possible to modify these subcontracts and still meet the Track 2 schedule.

Rather than modify the Track 2 schedule, a qualitative evaluation of the health effects from these three contaminants was performed to determine whether these constituents are a risk driver, or whether the additive risk from these contaminants would be insignificant. This evaluation involved the comparative estimation of risk for the soil ingestion, fugitive dust inhalation, and external exposure pathways using the average concentration of the contaminants measured in the HLLW tanks in 1989 (WINCO, 1989). The qualitative cancer risk for each contaminant was calculated by multiplying the average concentration in the HLLW by the slope factor. This risk was then compared to the risk from Cs-137 calculated in a similar manner. The results from this evaluation determined that the risk from these three contaminants (I-129, Np-237, and Tc-99) are at least two orders of magnitude less than the risk from Cs-137 for each of the pathways evaluated (Table 3-2). Since these three contaminants do not contribute significantly to the risk, it was decided not to analyze for them.

### 3.1.1 Contaminant Screening against Background

First, the maximum measured concentrations of contaminants were compared to published background concentrations as listed in Appendix E of the *Track 1 Sites: Guidance for Assessing Low Probability Hazard Sites at INEL* (DOE/ID-10340 1991), Background Soil Concentrations at the ICPP (WINCO 1993) or Assessment of Results from Gross Alpha and Gross Beta Screening Analysis of Soils and Comparison to Normal Background Radioactivity Levels at the Idaho National Engineering Laboratory (Anderson, D.A.). These values are listed in Table 3-1.

**Table 3-1. Background Concentrations and Physical Properties for Possible Site Contaminants**

OU: <u>3-07</u>				
Physical/Chemical				
Contaminant	Half-Life (years)	Background Concentration (pCi/g or mg/kg)	Kd (ml/g)	MW (g/mol)
Gross Alpha	NA	20 <sup>3</sup>	NA	NA
Gross Beta	NA	30 <sup>3</sup>	NA	NA
Cobalt-60	5.26	ND	10 <sup>2</sup>	60 <sup>5</sup>
Strontium-90	28.1	0.53 <sup>2</sup>	3 <sup>2</sup>	90 <sup>5</sup>
Technetium-99*	2.13E+05	ND	ND	99 <sup>5</sup>
Iodine-129*	1.57E+07	ND	0 <sup>2</sup>	129 <sup>5</sup>
Cesium-134	2.065	ND	500 <sup>2</sup>	134 <sup>5</sup>
Cesium-137	30.17	1.08 <sup>1</sup>	500 <sup>2</sup>	137 <sup>5</sup>
Cerium-144	0.78	ND	500 <sup>2</sup>	144 <sup>5</sup>
Uranium-234	2.46E+05	1.3 <sup>3</sup>	6 <sup>2</sup>	234 <sup>5</sup>
Uranium-235	7.04E+08	ND	6 <sup>2</sup>	235 <sup>5</sup>
Uranium-238	4.47E+08	1.3 <sup>3</sup>	6 <sup>2</sup>	238 <sup>5</sup>
Neptunium-237*	2.14E+06	ND	22 <sup>2</sup>	237 <sup>5</sup>
Plutonium-238	87.7	0.0024 <sup>2</sup>	22 <sup>2</sup>	238 <sup>5</sup>
Plutonium-239	2.41E+04	0.13 <sup>2</sup>	22 <sup>2</sup>	239 <sup>5</sup>
Plutonium-240	6.56E+03	0.029 <sup>2</sup>	22 <sup>2</sup>	240 <sup>5</sup>
Plutonium-242	3.75E+05	ND	22 <sup>2</sup>	242 <sup>5</sup>
Americium-241	432.7	0.008 <sup>2</sup>	340 <sup>2</sup>	241 <sup>5</sup>
Boron	NA	ND	ND	10.81 <sup>4</sup>
Cadmium	NA	5.3 <sup>2</sup>	6 <sup>2</sup>	112.40 <sup>4</sup>
Chromium (VI)	NA	28.3 <sup>1</sup>	1.2 <sup>2</sup>	52 <sup>4</sup>
Fluoride	NA	ND	0 <sup>2</sup>	38 <sup>4</sup>
Lead	NA	23.5 <sup>1</sup>	100 <sup>2</sup>	207.2 <sup>4</sup>
Manganese	NA	384 <sup>1</sup>	50 <sup>2</sup>	54.94 <sup>4</sup>

**Table 3-1. Background Concentrations and Physical Properties for  
Possible Site Contaminants**

OU: <u>3-07</u>				
Physical/Chemical				
Contaminant	Half-Life (years)	Background Concentration (pCi/g or mg/kg)	Kd (ml/g)	MW (g/mol)
Mercury	NA	<.04 mg/kg	100 <sup>2</sup>	200.59 <sup>4</sup>
Molybdenum	NA	ND	ND	95.94 <sup>4</sup>
Nickel	NA	32.9 <sup>1</sup>	100 <sup>2</sup>	58.69 <sup>4</sup>
Nitrate	NA	ND	ND	62 <sup>6</sup>
Tetrachloroethylene	NA	ND	23	165.8
1,1,1-Trichloroethane	NA	ND	5	133.4
1,1,2-trichloroethane	NA	ND	5	133.4
Trichloroethylene	NA	ND	5	131.4
<p>Reference:</p> <p>NA = Not Applicable</p> <p>ND = No Data</p> <p>* = Contaminant not analyzed during Track 2 investigation.</p> <p>1 95% upper tolerance limit concentration based on the report titled "Background Soil Concentrations for the ICPP", (WINCO 1993).</p> <p>2 Track 1 site: Guidance for Assessing Low Probability Hazard sites at INEL, DOE/ID-10340(91), October 1991.</p> <p>3 Anderson, D.A., "Assessment of Results from Gross Alpha and Gross Beta Screening Analyses of Soils and Comparison to Normal Background Radioactivity Levels at the Idaho National Engineering Laboratory".</p> <p>4 SAX's Dangerous Properties of Industrial Materials, Eight Edition, 1992</p> <p>5 Nuclides And Isotopes, Fourteenth Edition, 1989</p> <p>6 The MERCK INDEX, Eleventh Edition, 1989</p>				

Table 3-2. Calculated Risk from HLLW for Tc-99, I-129, Np-237, and Cs-137

Contaminant	Concentration(1) (mCi/l)	[SF] - Oral (Risk/pCi)	[SF] - Inhal (Risk/pCi)	[SF] - External (Risk/y per pCi/g)
Technetium-99	1.10E+07	1.30E-12	8.30E-12	6.00E-13
Iodine-129	4.00E+07	1.90E-10	1.20E-10	4.10E-09
Neptunium-237	9.60E+05	2.20E-10	2.90E-08	4.30E-07
Cesium-137	2.10E+11	2.80E-11	1.90E-11	2.00E-06
Contaminant		Calculated Risk (Oral)	Calculated Risk (Inhalation)	Calculated Risk (External)
Technetium-99		1.43E-05	9.13E-05	6.60E-06
Iodine-129		7.60E-03	4.80E-03	1.64E-01
Neptunium-237		2.11E-04	2.78E-02	4.13E-01
Cesium-137		5.88E+00	3.99E+00	4.20E+05
[SF] - Slope Factor (HEAST 1992)				
(1) Average concentration based on the "1989 Tank Farm Inventory" (Donovan 1989 [RID-08-89])				

Inorganic compounds, including metals, and radionuclides are considered contaminants if their maximum detected soil concentrations exceed the background concentration in any one of these reports. If there are no known background UTLs, the contaminants are retained for further evaluation. Organics present at detectable concentrations are considered contaminants, and retained for risk evaluation. Those contaminants that are essentially non-toxic under typical environmental scenarios (i.e., aluminum, calcium, iron, magnesium, potassium, sodium) were eliminated from further evaluation (DOE/ID-10389, Revision 3, 1992).

The background screening criteria of 20 pCi/g for alpha-emitting radionuclides and 30 pCi/g for beta-emitting radionuclides is described in a report by D.A. Anderson (EG&G Sample Management Office) using the data from a document titled *An Idaho National Engineering Laboratory Site Environmental Report for Calendar year 1990*, DOE/ID-12082(90), June 1991. The concentrations for most of the isotopes used to determine the background gross alpha and gross beta activities are not included in Table 3-1 since these isotopes are not part of the waste stream. The justification for these background screening levels are described in the following paragraphs.

#### Natural Alpha Activity:

Uranium-238 is present in INEL soils at an activity level of 1.3 pCi/g. There are seven alpha emitting daughter isotopes of U-238 (U-234, Th-230, Ra-226, Rn-222, Po-218, Po-214, and Po-210) which will also contribute 1.3 pCi/g each of alpha activity. The total alpha contribution of U-238 and its daughters is 8 times 1.3 for a total alpha activity of 10.4 pCi/g.

Thorium-232 is present in INEL soils at an activity level of 1.5 pCi/g. There are five alpha emitting daughter isotopes of Th-232 (Th-228, Ra-224, Rn-220, Po-216, and Po-212) which will also contribute 1.5 pCi/g each of alpha activity. The total alpha contribution of Th-232 and its daughters is 6 times 1.5 for a total alpha activity of 9 pCi/g.

Therefore, the total alpha activity from background in INEL soil from these isotopes is 19.4 pCi/g. The uncertainty placed on this value is plus or minus 20%, therefore, the range of alpha activity expected for typical INEL soil is 19.4 +/- 20% (3.9) or 15.5 to 23.3 pCi/g.

#### Natural Beta Activity:

The primary contributor to natural beta activity in INEL soils is Potassium-40 (K-40). This isotope has been shown to be present in INEL soils at an activity level of 19 pCi/g. In addition to the K-40, there is also a beta activity contribution from the beta emitting daughter isotopes of U-238 and Th-232.

There are five beta emitting daughter isotopes of U-238 (Th-234, Pb-214, Bi-214, Pb-210, and Bi-210). Each of these isotopes contributes 1.3 pCi/g of beta activity. The total beta contribution of these daughter isotopes is 5 times 1.3 for a total beta activity of 6.5 pCi/g.

There are four beta emitting daughter isotopes of Th-232 (Ra-228, Pb-212, Bi-212, and Ti-208). Each of these isotopes contributes 1.5 pCi/g of beta activity. The total beta contribution of these daughter isotopes is 4 times 1.5 for a total beta activity of 6 pCi/g.

There may be small contributions to beta activity from other isotopes such as cesium, but these are considered negligible for this calculation.

The total beta activity you would expect in INEL soils from the isotopes listed is 31.5 pCi/g. The uncertainty of this value is also 20%, therefore, the range of beta activity expected for typical INEL soil is 31.5 +/- 20% (6.3), or 25.2 to 37.8 pCi/g.

### 3.1.2 Contaminant Screening by Pathway

Following the contaminant screening against background concentrations, each contaminant of potential concern was then screened again for pathway completeness using current occupational, future recreational, and future residential scenarios. For the occupational scenario, it is assumed that site workers are in the vicinity of the environmentally controlled area on a daily basis without restriction. This scenario conservatively assumes that there are no institutional controls (i.e., unrestricted access) to the environmentally controlled area, and that the procedures described in the WINCO Radiation Controls Manual are not available. For the future recreational and residential scenarios, it is assumed that DOE will maintain restricted access for a period of 30 years, until approximately 2022. After that, it is assumed that individuals will live or recreate at the site under conditions that would exist at the site in the year 2022.

For the three scenarios (current occupational, future residential, and future recreational), exposure pathways were first evaluated for completeness in accordance with the Track 2 Guidance Document (DOE/ID-10389, Revision 3, 1992). The primary exposure pathways evaluated were: 1) incidental ingestion of contaminated soil, 2) inhalation of contaminated fugitive dust, 3) inhalation of volatiles, 4) ground water ingestion, and 5) external exposure to radionuclides.

The screening criteria for determining pathway completeness is the depth at which the contamination was detected. For the occupational scenario, all contaminants detected in the upper six inches of soil were retained for further evaluation in the soil ingestion and inhalation pathways. Radionuclides detected in the upper four feet of the soil were also retained for further evaluation of the external exposure pathway for this scenario. All contaminants detected in the upper 10 feet of soil were retained for further evaluation in the soil ingestion, inhalation, and external exposure pathways for the future residential scenario. For the future recreational scenario, the Track 2 Guidance does not indicate the specific target depths to be used for screening. For this assessment, the same depth criteria used for the occupational scenario was used for the future recreational scenario: upper six inches for soil ingestion and inhalation pathways, and four feet for external exposure pathway.



The two release mechanisms for the inhalation pathway are fugitive dust emissions and volatilization. Contaminants are considered potentially volatile if they exhibit the following characteristics: vapor pressure greater than  $10^{-6}$  mm Hg, molecular weight less than 200, and a Henry's Constant greater than  $10^{-4}$  (DOE/ID-10389 1992). Contaminants not eliminated by these screenings are listed in Table 3-1 with physical and characteristics that are pertinent to contaminant mobility and volatilization.

For the ground water pathway, all contaminants detected at the site are evaluated for potential impacts to the ground water using the computer model GWSCREEN.

### 3.2 Toxicity Assessment

Once the contaminants of potential concern are determined for a given site, those contaminants were then evaluated for their potential adverse health effects. Exposure to non-radioactive contaminants can potentially result in toxic effects that are classified as either noncarcinogenic (i.e., systemic toxic effects other than cancer) or carcinogenic (i.e., cancer). The principal adverse biological effects associated with exposure to chronic low levels of radioactive contaminants is carcinogenicity. For the purpose of this assessment, only the risks associated with chronic exposure were evaluated.

Table 3-3 lists the chronic toxicological values obtained from the International Risk Information System (IRIS) Data Base or from the Health Effects Assessment Summary Tables (HEAST) (EPA 1992b). These values reflect extensive evaluation and summarization of toxicity information and dose-response relationships from the scientific community by EPA for the purpose of assessing potential human health risks at environmentally regulated sites. The toxicity values in Table 3-3 taken by footnote from the HEAST have only provisional status, and are distinguished from those values obtained from IRIS. The contaminants that do not have health based concentrations listed either in IRIS or in the HEAST, were researched through other sources and evaluated independently. Appendix D describes the health effects for each noncarcinogenic and carcinogenic contaminant.

#### 3.2.1 Noncarcinogenic Effects

Noncarcinogenic effects resulting from exposures to chemicals were evaluated using chronic toxicity values; chronic reference concentrations (RfC), or chronic reference doses (RfD) for inhalation and oral exposures, respectively. The chronic RfC or RfD is an estimate of the daily exposure to which even a sensitive individual might be exposed without an appreciable risk of deleterious effects during the lifetime. For inhalation exposure calculations, conversion of the chronic RfC value ( $\text{mg}/\text{m}^3$ ) to a corresponding inhaled dose ( $\text{mg}/\text{kg}\text{-day}$ ) is provided for in the Track 2 intake equation for this pathway. The chronic reference dose for oral exposure is reported as  $\text{mg}/\text{kg}\text{-day}$  and is converted in the Track 2 intake equation to a corresponding concentration in the drinking water for ground water exposure.

Table 3-3. Contaminant Carcinogenicity or Toxicity Measures and Uncertainty Factors

OU: 3-07

## Physical/Chemical

Contaminant	[RfD] (oral) (mg/kg/day)	UF	[RfC] (inhal) (mg/m <sup>3</sup> )	UF	[SF] (oral) (Risk/pCi)	[SF] (inhal) (Risk/pCi)	[SF] (external) (Risk/yr per pCi/g soil)	Class
Cobalt-60	NA	NA	NA	NA	1.5E-11 <sup>(1)</sup>	1.5E-10 <sup>(1)</sup>	8.6E-06 <sup>(1)</sup>	
Strontium-90	NA	NA	NA	NA	3.6E-11 <sup>(1)</sup>	6.2E-11 <sup>(1)</sup>	0.0E+00 <sup>(1)</sup>	
Technetium-99	NA	NA	NA	NA	1.3E-12 <sup>(1)</sup>	8.3E-12 <sup>(1)</sup>	6.0E-13 <sup>(1)</sup>	
Iodine-129	NA	NA	NA	NA	1.9E-10 <sup>(1)</sup>	1.2E-10 <sup>(1)</sup>	4.1E-09 <sup>(1)</sup>	
Cesium-134	NA	NA	NA	NA	4.1E-11 <sup>(1)</sup>	2.8E-11 <sup>(1)</sup>	5.2E-06 <sup>(1)</sup>	
Cesium-137	NA	NA	NA	NA	2.8E-11 <sup>(1)</sup>	1.9E-11 <sup>(1)</sup>	2.0E-06 <sup>(1)</sup>	
Cerium-144	NA	NA	NA	NA	1.6E-11 <sup>(1)</sup>	3.4E-10 <sup>(1)</sup>	2.5E-08 <sup>(1)</sup>	
Uranium-234	NA	NA	NA	NA	1.6E-11 <sup>(1)</sup>	2.6E-08 <sup>(1)</sup>	3.0E-11 <sup>(1)</sup>	
Uranium-235	NA	NA	NA	NA	1.6E-11 <sup>(1)</sup>	2.5E-08 <sup>(1)</sup>	2.4E-07 <sup>(1)</sup>	
Uranium-238	NA	NA	NA	NA	2.8E-11 <sup>(1)</sup>	5.2E-08 <sup>(1)</sup>	3.6E-08 <sup>(1)</sup>	
Neptunium-237	NA	NA	NA	NA	2.2E-10 <sup>(1)</sup>	2.9E-08 <sup>(1)</sup>	4.3E-07 <sup>(1)</sup>	
Plutonium-238	NA	NA	NA	NA	2.2E-10 <sup>(1)</sup>	3.9E-08 <sup>(1)</sup>	2.8E-11 <sup>(1)</sup>	
Plutonium-239	NA	NA	NA	NA	2.3E-10 <sup>(1)</sup>	3.8E-08 <sup>(1)</sup>	1.7E-11 <sup>(1)</sup>	
Plutonium-240	NA	NA	NA	NA	2.3E-10 <sup>(1)</sup>	3.8E-08 <sup>(1)</sup>	2.7E-11 <sup>(1)</sup>	
Plutonium-242	NA	NA	NA	NA	2.2E-10 <sup>(1)</sup>	3.6E-08 <sup>(1)</sup>	2.3E-11 <sup>(1)</sup>	
Americium-241	NA	NA	NA	NA	2.4E-10 <sup>(1)</sup>	3.2E-08 <sup>(1)</sup>	4.9E-09 <sup>(1)</sup>	
Contaminant	[RfD] (oral) (mg/kg/day)	UF	[RfC] (inhal) (mg/m <sup>3</sup> )	UF	[SF] (oral) [(mg/kg)/d] <sup>-1</sup>	[SF] (inhal) [(mg/kg)/d] <sup>-1</sup>	[SF] (external) (Risk/yr per pCi/g soil)	Class
Boron	9.0E-02 <sup>(2)</sup>	100 <sup>(1)</sup>	2.0E-2 <sup>(1)</sup>	100	ND	ND	NA	
Cadmium	Water 5.0E-04 <sup>(2)</sup> Food 1.0E- 3 <sup>(2)</sup>	10 <sup>(2)</sup> 10 <sup>(2)</sup>	ND	ND	ND	6.1E-00 <sup>(2)</sup>	NA	B <sup>(2)</sup> B1 <sup>(2)</sup>
Chromium (VI)	5.0E-03 <sup>(2)</sup>	500 <sup>(2)</sup>	ND	ND	ND	4.1E-01 <sup>(1)</sup>	NA	A <sup>(2)</sup>
Fluoride	6.0E-02 <sup>(2)</sup>	1 <sup>(2)</sup>	ND	ND	ND	ND	NA	
Lead	ND	ND	1.5E-3	ND	ND	ND	NA	B2 <sup>(2)</sup>

Table 3-3. Contaminant Carcinogenicity or Toxicity Measures and Uncertainty Factors

OU: 3-07

## Physical/Chemical

Contaminant	[RfD] (oral) (mg/kg/day)	UF	[RfC] (inhal) (mg/m <sup>3</sup> )	UF	[SF] (oral) [(mg/kg)/d] <sup>-1</sup>	[SF] (inhal) [(mg/kg)/d] <sup>-1</sup>	[SF] (external) (Risk/yr per pCi/g soil)	Class
Manganese	1.0E-01 <sup>(2)</sup>	1 <sup>(2)</sup>	4.0E-04 <sup>(2)</sup>	300 <sup>(2)</sup>	ND	ND	NA	
Mercury (Inorganic)	3.0E-04 <sup>(1)</sup>	1000 <sup>(1)</sup>	3.0E-04 <sup>(1)</sup>	30 <sup>(1)</sup>	ND	ND	NA	D <sup>(2)</sup>
Molybdenum	5.0E-3 <sup>(1)</sup>	30 <sup>(1)</sup>	ND	ND	ND	ND	NA	
Nickel	2.0E-02 <sup>(2)</sup>	300 <sup>(2)</sup>	ND	ND	ND	8.4E-1 <sup>(1)</sup>	NA	A <sup>(1)</sup>
Nitrate	1.6E-00 <sup>(2)</sup>	1 <sup>(2)</sup>	ND	ND	ND	ND	NA	
Hexone	5.0E-02 <sup>(1)</sup>	1000 <sup>(1)</sup>	8.0E-02 <sup>(1)</sup>	1000 <sup>(1)</sup>	ND	ND	NA	
Tetrachloroethylene	1.0E-2 <sup>(2)</sup>	1000 <sup>(2)</sup>	ND <sup>(2)</sup>	NA	5.2E-2 <sup>(5)</sup>	2.0E-3 <sup>(5)</sup>	NA	B2 <sup>(5)</sup>
Tributylphosphate	ND <sup>(2)</sup>	<sup>(2)</sup>	ND <sup>(2)</sup>	<sup>(2)</sup>	ND <sup>(2)</sup>	ND <sup>(2)</sup>	NA	
1,1,1-Trichloroethane	9.0E-2 <sup>(1)</sup>	1000 <sup>(1)</sup>	1.0E+00 <sup>(1)</sup>	100 <sup>(1)</sup>	ND	ND	NA	D <sup>(2)</sup>
1,1,2-Trichloroethane	4.0E-03 <sup>(2)</sup>	1000 <sup>(2)</sup>	ND	ND	5.7E-02 <sup>(2)</sup>	5.7E-02 <sup>(1)</sup>	NA	C <sup>(2)</sup>
Trichloroethylene	6.0E-3 <sup>(3)</sup>	3000 <sup>(3)</sup>	ND	ND	1.1E-02 <sup>(3)</sup>	6.0E-3 <sup>(3)</sup>	NA	B2 <sup>(3)</sup>

## Reference:

(1) HEAST (EPA 1992b)

(2) IRIS 1992

(3) U.S. EPA Office of Research and Development.

Direct Communication. Sept. 1992

Provisional values, while under EPA review.

(4) 1986 Ambient Air Quality Criteria (EPA-600/8 - 83/028a-df)

(5) Memorandum from Kenneth A. P (Director, Superfund Health Risk Technical Support Center) to Carol Sweeney (U.S. EPA Region X) dated March 30, 1992

ND = No Data

NA = Not Applicable

A = Known Human Carcinogen

B1 = Probable Human Carcinogen (limited evidence in humans)

B2 = Probable Human Carcinogen (sufficient evidence in animals)

C = Possible Carcinogen

D = Not Classifiable as Human Carcinogen

Also included in the HEAST and IRIS are uncertainty factors (UF) for each RfC or RfD which reflect scientific judgment regarding the various types of data used to estimate the reference values. An uncertainty factor of 10 is used to account for variation in human sensitivity among populations. An additional 10-fold factor may also be used to account for each of the uncertainties assumed when extrapolating from animal data to humans, when extrapolating from a Lowest Observed Adverse Effect Level (LOAEL) to a No Observed Adverse Effect Level (NOAEL), and when extrapolating from subchronic to chronic exposure. In order to reflect professional assessment of the uncertainties of the study and the data base not explicitly addressed by the above uncertainty factors, an additional uncertainty factor ranging from 0 to 10 is sometimes applied. The default value for this last uncertainty factor is 1 (EPA 1992b).

The possible noncarcinogenic adverse health effects for the potential contaminants of concern that were identified for this operable unit, and which were not eliminated during the pathway screening, are described in Appendix D.

### 3.2.2 Carcinogenic Effects

Carcinogenic effects resulting from exposures to radionuclides or chemicals were evaluated using slope factors (SF) as listed by IRIS or in the HEAST. Slope factors are contaminant and pathway specific and represent risk per unit dose (i.e., risk per mg/kg-day, risk/pCi).

For a chemical carcinogen, the SF generally represents an upper bound or the upper 95th percent confidence interval value. This upper bound value is conservatively estimated from many sources of data. In some cases, the data may be from studies with high dosages in animals, then extrapolated to low dosages in humans. The true risk to humans, while not identifiable, is not likely to exceed the upper-bound estimate and in fact may be lower (EPA 1992b).

All radionuclides are classified by EPA as Class A human carcinogens. The principal adverse biological effect associated with exposures from radioactive contaminants in the environment is carcinogenicity. The concentrations of radionuclides associated with potential carcinogenic effects are typically orders of magnitude lower than those associated with systemic toxicity. The data on radionuclide carcinogenicity are taken primarily from studies of human populations exposed to high levels of radiation. Extrapolation of these data to the much lower doses associated with radionuclide environmental contamination is the major source of uncertainty in determining low-level radiation risks. For radioactive contaminants, the SFs are considered best estimate values, rather than the upper-bound estimates for chemical carcinogens (EPA/540/1-89 002, 1989).

The possible carcinogenic adverse health effects for potential contaminants of concern that were identified for this operable unit, and which were not eliminated during the pathway screening, are described in Appendix D.

### 3.3 Exposure Assessment

During the exposure assessment, the magnitude, frequency, duration, and route of exposure for chemicals or radionuclides potentially present at, or migrating from the site are estimated. Exposure assessment provides the exposure factors and equations necessary for calculating risk from intake of contaminants at levels present at the site (forward calculations). The contaminant concentration term in the intake equation is the upper bound 95th percent confidence interval of the arithmetic mean of the measured concentration, and is estimated to be the concentration contacted over the exposure period. Although this concentration does not reflect the maximum concentration that could be contacted at any one time, it is regarded as a reasonable estimate. For the ground water pathway, the contaminant concentration in the source term is the arithmetic mean over the entire site as recommended in the Track 2 Guidance Document (DOE/ID-10389, Rev. 3).

#### 3.3.1 Basic Equations used for Exposure Calculations

The following sections detail the basic equations and default parameters used to calculate intake values from the sample data concentrations and forward calculations of risk from those estimated intakes.

**3.3.1.1 Intake and Risk Equations** For those sites with available sample data, the Track 2 Guidance Document provides the equations used for calculating intake values and forward calculations of risk from those intakes. The appropriate intake values and associated hazard quotients or risk values for contaminants were calculated for each exposure pathway and scenario. The definitions and values for each parameter are provided in Table 3-4.

Intake values for the ingestion, and inhalation of radioactive contaminants were calculated using the following basic equation:

$$\text{Intake} = C \times IR \times EF \times ED \quad (7)$$

where:

Intake	=	Radionuclide-specific lifetime intake (pCi)
C	=	Concentration of radionuclide in the medium (pCi/g)
IR	=	Intake rate (medium dependent)
EF	=	Exposure frequency (d/yr or hr/d)
ED	=	Exposure duration (yr)

The above equation was also used to evaluate external exposure to radionuclides, with the exposure calculated using the following equation:

$$IR_{\text{ext}} = ET \times CF \quad (8)$$

where:

$IR_{\text{ext}}$	=	External exposure rate (yr/d)
ET	=	Exposure time (hr/d)
CF	=	Conversion factor (1.14 E-04 yr/hr)

Table 3-4. Risk Assessment Parameters

OU: <u>3-07</u>				
Scenario				
Parameter	Definition	Occupational	Residential	Recreational
TR	Target excess individual lifetime cancer risk	1E-06	1E-06	1E-06
THQ	Target Hazard quotient	1	1	1
BW	Body Weight	Adult: 70kg	Adult: 70 kg Child: 15 kg	Adult: 70 kg
AT	Carcinogens Averaging time Non-Carcinogens	365 d/yr x 70 yr 365 d/yr x 25 yr	365 d/yr x 70 yr 365 d/yr x 25 yr	365 ds/yr x 70 yr 365 d/yr x 25 yr
EF	Exposure frequency	250 days/year, 8 hours/day	350 days/year, 24 hours/day	1 day/year, 24 hours/day
ED	Exposure duration	25 years	30 years Child: 6 years Adult: 24 years	30 years
IR	Pathway-specific contact rate	Soil Ingestion: 50 mg/day Inhalation: 20 m <sup>3</sup> /day Water Ingestion: 1 L/day	Soil Ingestion: Child: 200 mg/day Adult: 100 mg/day Inhalation: 20 m <sup>3</sup> /day Water Ingestion: 2 L/day	Soil Ingestion: 100 mg/d Inhalation: 20 m <sup>3</sup> /da
V	Wind speed	3.4 m/s	3.4 m/s	3.4 m/s
MH	Mixing height	2m	2m	2m
E <sub>10</sub>	Average respirable particulate per unit area	4.2E-4 g/m <sup>2</sup> -hr	4.2E-4 g/m <sup>2</sup> -hr	4.2E-4 g/m <sup>2</sup> -hr
E	Soil porosity	0.35	0.35	0.35
P <sub>s</sub>	Soil density	1.5 g/cm <sup>3</sup>	1.5 g/cm <sup>3</sup>	1.5 g/cm <sup>3</sup>
T	Exposure interval	7.9 E08 seconds	9.5 E08 seconds	9.5 E08 seconds
OC	Organic carbon content of soil	0.01	0.01	0.01

The soil-to-air particulate emission factor (PEF) is based on the relationship derived by Cowherd et al. (1985), where an estimation of the respirable particulate emissions from wind erosion of surfaces with an unlimited reservoir of erodible material can be related to field and climatic factors. It conservatively assumes that an individual is located at the downwind boundary of the site, that the size distribution mode for the soil is 0.5 mm, and that the roughness height is 0.1 cm. The following equation, taken from the Track 2 Guidance Document (DOE/ID-10389, Rev 3.), is used to calculate a PEF for each site.

$$\text{PEF} = (\text{LS} \times \text{V} \times \text{MH} \times \text{CF}_1 \times \text{CF}_2) / (\text{A} \times \text{E}_{10}) \quad (9)$$

where:

PEF	=	particulate emission factor ( $\text{m}^3/\text{kg}$ )
LS	=	width of contaminated area (m)
V	=	wind speed in mixing zone (3.4 m/s)
MH	=	mixing height (2 m)
$\text{CF}_1$	=	correction factor (3600 s/hr)
$\text{CF}_2$	=	correction factor (1000 g/kg)
A	=	area of contamination ( $\text{m}^2$ )
$\text{E}_{10}$	=	Annual average respirable particulate matter per unit area of contaminated surface is $4.2\text{E}-04 \text{ g/m}^2\text{-hr}$ (DOE/ID-10389, Rev 3).

The soil-to-air volatilization factor (VF) is used to define the relationship between the concentration of the contaminant in soil and the volatilized contaminant in the air. Volatilization of a contaminant from soil and/or water is dependent on such factors as its molecular weight, vapor pressure, and solubility. These properties, in conjunction with the Henry's Law Constant, for a contaminant can be used to predict which contaminants are likely to volatilize. For the purposes of screening contaminants, a contaminant is considered potentially volatile if the vapor pressure is greater than  $10^{-6}$  mm Hg, the molecular weight is less than 200, and the Henry's Constant is greater than  $10^{-4}$ . It is assumed that the surface of the contaminated material is exposed directly to the atmosphere and onsite ambient air concentrations of contaminants are based directly on the emission rate of the volatile to the air from contaminated soil. The following equation, taken from the Track 2 Guidance Document (DOE/ID-10389, Rev 3), is used to calculate a PEF for each volatile contaminant for each site.

$$\text{VF} = \frac{[(\text{LS} \times \text{V} \times \text{MH}) / \text{A}] \times ((3.14 \times \alpha \times \text{T})^{1/2})}{(2 \times \text{D}_{\text{ei}} \times \text{E} \times \text{K}_{\text{as}} \times \text{CF})} \quad (10)$$

where:

VF	=	volatilization factor ( $\text{m}^3/\text{kg}$ )
LS	=	width of contaminated area (m)
V	=	site-specific wind speed in mixing zone (3.4 m/s)
MH	=	mixing height (2 m)
A	=	area of contamination ( $\text{m}^2$ )
$\alpha(\text{cm}^2/\text{s})$	=	$\frac{(D_{ei} \times E)}{(E + (p_s) \times (1 - E)/K_{as})}$
T	=	exposure interval (s)
$D_{ei}$	=	effective diffusivity ( $D_i \times E^{0.33}$ ) ( $\text{cm}^2/\text{s}$ ) where $D_i$ = diffusivity ( $\text{cm}^2/\text{s}$ ) and $E^{0.33}$ = constant for soil
E	=	soil porosity (unitless)
$K_{as}$	=	soil/air partition coefficient [ $(H/K_d) \times 41$ ] ( $\text{g soil}/\text{cm}^3$ air) where H = Henry's constant; $K_d$ = distribution constant in soil and 41 = units conversion factor.
CF	=	conversion factor (0.001 kg/g)
$p_s$	=	true soil density ( $\text{g}/\text{cm}^3$ )

Once the soil-to-air PEF or VF is calculated using the site- and chemical-specific data, that value can be used in the appropriate exposure scenario equations presented in Table 3-5.

For the ground water ingestion pathway, the calculated concentration in water ( $C_{wa}$ ) is estimated with the GWSCREEN model. The  $C_{wa}$  is then used in the appropriate intake equations to calculate the intake and potential risk (Table 3-5).

For non-carcinogenic effects, the intake values for noncarcinogenic contaminants are divided by the appropriate chronic reference dose to yield a hazard quotient (HQ). The HQ is a measure used to describe the potential for noncarcinogenic toxicity to occur in an individual and assumes that there is a level of exposure (i.e., RfD) below which it is unlikely for even sensitive populations to experience adverse health effects. If the exposure level (intake) exceeds the threshold (i.e., if  $I/\text{RfD}$  exceeds unity), there may be concern for potential noncancer effects. As a rule, the greater the value of  $I/\text{RfD}$  above unity the greater the level of concern. The level of concern does not increase linearly as the RfD is approached or exceeded.

To estimate potential cancer risks, the slope factor converts the estimated daily intake or exposure value for each carcinogenic contaminant averaged over a lifetime of exposure directly to incremental risk of an individual developing cancer. Relatively low intakes are most likely from environmental exposure and it generally can be assumed that the dose-response relationship will be linear in the low-dose portion of the multistage model dose-response curve. Under this assumption, the slope factor is a constant, and risk is directly related to intake ( $\text{Risk} = \text{CDI} \times \text{SF}$ ). This linear equation is valid only at low risk levels (i.e., risk above 0.01), the one-hit equation, which is consistent with the linear low-dose model ( $\text{Risk} = 1 - \exp^{-(\text{CDI} \times \text{SF})}$ ), is used instead. According to the NCP, those contaminants with a HQ greater than 1 or a cancer risk greater than  $10^{-6}$  may pose unacceptable health risks for that pathway and scenario.



**Table 3-5. Abbreviated Equations for Intake and Risk-Based Concentrations.**  
**INTAKE EQUATIONS**

<b>Occupational Scenario</b>			
	<b>Carcinogens</b>	<b>Noncarcinogens</b>	<b>Radioactive</b>
Soil Ingestion	Intake = Cs X 1.7E-07	Intake = Cs X 4.9E-07	Intake = Cs X 3.1E+02
Inhalation-Fugitive Dust	Intake = Cs X 7.0E-02/PEF	Intake = Cs X 2.0-01/PEF	Intake = Cs X 1.2E08/PEF
Inhalation-Volatiles	Intake = Cs X 7.0E-02/VF	Intake = Cs X 2.0E-01/VF	Not-Applicable
Groundwater Ingestion	Not-Applicable	Not-Applicable	Not-Applicable
Direct or External Exposure	Not-Applicable	Not-Applicable	Exposure = Cs x 5.7
<b>Residential Scenario</b>			
Soil Ingestion	Intake = Cs x 1.6E-06	Intake = Cs X 3.7E-06	Intake = Cs X 1.3E+03 X e <sup>(-0.0347t)</sup>
Inhalation-Fugitive Dust	Intake = Cs X 1.2E-01/PEF	Intake = Cs X 2.7E-01/PEF	Intake = Cs X 2.1E+08 X e <sup>(-0.0347t)</sup> /PEF
Inhalation- Volatiles	Intake = Cs X 1.2E-01/VF	Intake = Cs X 2.7E-01/VF	Not-Applicable
Groundwater Ingestion	Intake = Cwa x 1.2E-02	Intake = Cwa x 2.73-02	Intake = Cwa x e <sup>(-0.0347t)</sup> x 2.1E04
Direct or External Exposure	Not-Applicable	Not-Applicable	Exposure = Cs x e <sup>(-0.0347t)</sup> x 2.9E+01
<b>Recreational Scenario</b>			
Soil Ingestion	Intake = Cs X 1.7E-09	Intake = Cs X 3.9E-09	Intake = Cs X 3E00 X e <sup>(-0.0347t)</sup>
Inhalation-Fugitive Dust	Intake = Cs X 3.3E-04/PEF	Intake = Cs X 7.8E-04/PEF	Intake = Cs X 6E+05 X e <sup>(-0.0347t)</sup> /PEF
Inhalation-Volatiles	Intake = Cs X 3.3E-04/VF	Intake = Cs X 7.8E-04/VF	Not-Applicable
Groundwater Ingestion	Not-Applicable	Not-Applicable	Not-Applicable
Direct or External Exposures	Not-Applicable	Not-Applicable	Exposure = Cs X e <sup>(-0.0347t)</sup> x 2.7E-02
<b>Intake Equations:</b> All intakes for non-radioactive contaminants expressed as mg/kg day except groundwater ingestion pathway (mg/L-day) Intakes for radionuclide ingestion and inhalation pathways expressed as lifetime intake in pCi; external exposure intake expressed as pCi - yr/g.			

**Table 3-5. Abbreviated Equations for Intake and Risk-Based Concentrations.**

**Risk-based Soil Concentrations:**

- a. All equations are expressed as soil concentrations in mg/kg, except groundwater ingestion pathway (mg/L) for non-radioactive contaminants.
- b. All equations for radioactive contaminants are expressed as pCi/g in soil, except groundwater ingestion pathway (pCi/L).
- c. All equations provide screening concentrations in water.

Cs	=	Soil Concentration
Cwa	=	Water Concentration
PEF	=	Site-specific soil to air respirable particulate emission factor
VF	=	Site-specific, chemical-specific volatilization factor
e	=	Base of the natural logarithms (~2.71828)
t	=	Radionuclide half-life (yr)
T	=	Time elapsed to future exposure (ie; 100 years)
SF	=	Chemical-specific slope factor.
RfD	=	Chemical-specific chronic reference dose.

### 3.3.2 Exposure Scenarios

The following three exposure scenarios were evaluated, as recommended by Track 2 Guidance Document (DOE/ID-10389, Rev.3): current occupational, future residential, and future recreational. The scenarios and associated assumptions are described in the following sections.

**3.3.2.1 Current Occupational** The current receptor population for exposure to contamination present at this operable unit is adult workers at the ICPP. The area within the tank farm is under very tight institutional control with a fenced and controlled perimeter, and a present ground surface cover consisting of a liner plus 2.5 feet of clean fill soil. Any work being performed in this area is controlled and monitored by the WINCO Environmental Safety and Health Department.

For the risk assessment, however, it is conservatively assumed that workers are present in the tank farm area on a daily basis, and the occupational default parameters from the Track 2 Guidance Document are applicable (Table 3-4). The potential exposure pathways for the current occupational scenario include incidental soil ingestion, inhalation of fugitive dust, inhalation of volatiles, and external exposure to gamma radiation.

The ground water pathway for the current occupational scenario was not evaluated for the following three reasons. First, the potable water well (CPP-4) is located approximately 1500 feet upgradient from the tank farm and given the high ground water flow velocities in the aquifer, it is unlikely that any contaminants from the tank farm could migrate to the production well. Second, the groundwater ingestion pathway is evaluated under the future residential and due to the higher exposure factors, this scenario should be more conservative than for the current occupational scenario. Finally, the contaminant travel time to the aquifer is recalculated to be longer than 30 years based on the results from GWSCREEN. Therefore, it is more appropriate to evaluate the effects from ground water ingestion to a future residential receptor.

**3.3.2.2 Future Residential** For the Track 2 risk assessment, however, it was assumed that a residential receptor would begin residence at this site in 30 years. The residential default parameters from the Track 2 Guidance Document as provided in Table 3-4 were used (DOE/ID-10389, Rev.3). The potential exposure pathways for the residential exposure scenario were incidental soil ingestion, inhalation of fugitive dust, inhalation of volatiles, ingestion of ground water, and external exposure to gamma radiation.

**3.3.2.3 Future Recreational** For the future recreational scenario, it was assumed that adult individuals will use the site for recreational purposes such as hiking, hunting or camping. It was also assumed that the contaminant conditions will be those that would exist at the site in 30 years assuming present contaminant levels were left intact.

Potential pathways considered for the recreational exposure scenario were incidental soil ingestion, inhalation of fugitive dust, inhalation of volatiles, and external exposure to gamma radiation as recommended by the Track 2 Guidance Document (Table 3-4).

### 3.3.3 Exposure Pathways and Release Mechanisms

The following sections discuss the exposure pathways assessed for each of the scenarios described above.

**3.3.3.1 Soil Ingestion** This pathway assumes that both children and adults incidentally ingest a small amount of soil each day (i.e., hand to mouth contacts, ingestion of air borne particulates via food, other objects, or through inhalation). Default values describing the intake are listed in Table 3-4.

For the incidental soil ingestion pathway for the future residential scenario, it is recommended by the Track 2 Guidance Document that non-radioactive contaminant intake values (Eq. 7) be averaged over 30 years to include both childhood years (ED = 6 years, BW = 15 kg, IR = 200 mg/day) and adult years (ED = 24 years, BW = 70 kg, IR = 100 mg/day). An additional factor of  $1\text{E-}06$  kg/mg is used in the denominator to convert the soil ingestion intake rate to kg of soil/day for non-radioactive contaminants.

To calculate the intake rates for the incidental soil ingestion of radioactive contaminants (Eq. 8), it is necessary to include an additional factor of  $1\text{E-}3$  g/mg in the denominator to convert the soil ingestion intake rate to grams/day. For the future scenarios, (i.e., in 100 years) all equations are modified to account for radioactive decay: the intake equations are multiplied by the decay factor of  $e^{-(0.693/t)T}$ , where  $t$  = half life of the radionuclide and  $T$  = time until exposure occurs (30 years).

Abbreviated equations for the calculation of both the forward intake values and for the backward risk-based concentrations with the parameter default values included for the soil ingestion pathway are provided in Table 3-5.

**3.3.3.2 Inhalation** For the inhalation pathway, both volatile and non-volatile contaminants may be potential health hazards. Non-volatile contaminants in soils can be resuspended as fugitive dust, and be potential health hazards via the inhalation exposure pathway. Equations 7 and 8 are modified to include the site specific soil-to-air particulate factor (PEF) as recommended in the Track 2 Guidance Document.

Abbreviated equations for the calculation of the forward intake values with the parameters default values included for both the inhalation of fugitive dust and volatiles are provided in Table 3-5.

**3.3.3.3 Ground Water Ingestion** Potential exposure to a future residential human population from the ingestion of ground water was evaluated with the semi-analytical model GWSCREEN. This model assesses the ground water pathway from the leaching of radioactive and non-radioactive substances from surface or buried sources to the ground water. The results from GWSCREEN, including the contaminant travel times, are provided in the risk assessment summary tables for each site.

The computer model GWSCREEN was developed by EG&G Idaho for assessing and screening the ground water pathway when field data is limited. This code was specially developed for the implementation of Track 1 and Track 2 assessments of low probability hazard sites at the INEL. The results from the model are semi-quantitative with the resultant ground water concentration being estimated

using a mass conservation approach. The complete description for the code can be found in *GWSCREEN: A Semi-Analytical Model for Assessment of the Ground Water Pathway from Surface or Buried Contamination: Theory and User's Manual* (Rood, March 1992).

To determine the exposure potential for the ground water pathway for this operable unit, a net water infiltration rate of 0.1 m/y was selected based upon the draft Track 2 Guidance Document (DOE/ID-10389). This infiltration rate corresponds to a volumetric moisture content of 0.34 m<sup>3</sup>/m<sup>3</sup> for the sediments and 0.068 m<sup>3</sup>/m<sup>3</sup> for the basalts based upon Figure 3-2 and Figure 3-3, respectively, in the GWSCREEN User's Manual (EGG-GEO-10158). The bulk densities of the geologic materials were based upon the recommended values in the Track 2 Guidance Document (DOE/ID-10389, Rev. 3) and correspond to 1.5 g/cm<sup>3</sup> for sediments and 1.9 g/cm<sup>3</sup> for basalts. The half-life and molecular weights of the various contaminants were taken from "Nuclides and Isotopes, Fourteen Edition", (General Electric Company, 1989).

The location for the receptor water well was conservatively selected to be in the middle of the downgradient edge of the environmentally controlled unit. This well location corresponds to the input parameter for the receptor distance parallel to ground water flow (XD) equal to AL/2 and the receptor distance perpendicular to ground water flow (YD) equal to 0 m. The value for the well screen "mixing" thickness was set at 15 m based upon the Track 2 Guidance Document.

The parameters describing the ground-water flow component in GWSCREEN include dispersivity, velocity, and effective porosity. The values selected for longitudinal dispersivity and transverse dispersivity were 9 m and 4 m, respectively, according to the draft Track 2 Guidance Document (July 1992). The effective porosity of the basalt is 10 percent. The value used for the saturated pore velocity in the aquifer is based upon documented tracer tests performed by the USGS at the ICPP and was set at 1210 m/y.

The value used for the thickness of the unsaturated zone was set at 16 m, corresponding to the thickness of the sedimentary interbeds beneath the ICPP. Using a 16 m thickness from the bottom of the contaminated source to the top of the aquifer conservatively assumes that contaminants travel instantaneously through the basalt and that no contaminant retardation occurs in the basalt.

The sorption coefficients (Kd's) selected for the site contaminants were obtained from Appendix F in the Track 1 Guidance Document (DOE/ID-10340) or from other sources and are listed with appropriate reference notations in Table 3-1. If a Kd was not available for a particular contaminant, it was conservatively set to zero for the ground water pathway assessment. The source of contamination was assumed to be the entire contaminated volume of soil with a concentration equal to the arithmetic mean homogeneously distributed. A complete listing of the input parameters used for GWSCREEN are provided in Table 3-6.

**3.3.3.4 Direct and External Exposures** Direct exposure is assessed when it is assumed that there will be either dermal contact with soil contaminants, which is significant only for organic compounds, or there will be external exposure to radionuclides that have significant photon emissions. Since significant organic compounds were not detected at OU 3-07, only external exposure to radionuclides will be discussed in this section.

Exposure rates, and estimated external exposure to radionuclide contaminants with photon emissions were calculated using equations 7 and 8, respectively. Risk was then estimated by multiplying the estimated exposure by the external exposure slope factor for each radionuclide obtained from the HEAST. For the future residential and recreational scenarios, all equations are modified to account for 30 years of radioactive decay; equations were multiplied by the decay factor ( $e^{-10.693/tT}$ ), where  $t$  = half life of the radionuclide and  $T$  = time until exposure occurs.

All exposure rates for radionuclides are based on the upper 95 percent confidence interval of the arithmetic mean of the detected soil concentrations. For external exposure, it is assumed that the contaminants are homogeneously distributed throughout the soil at this concentration, and that the occupational and residential receptors are standing on the contaminated soil for 8 hr/day, 250 days per year for 25 years, and 24 hr/day, 350 days per year for 30 years, respectively.

#### 3.3.4 Uncertainty Evaluation

The sources of uncertainty assessed for this operable unit fall into the following broad categories.

1. Contaminant specific variables;
2. Site specific variables;
3. Exposure assessment assumptions and default values;
4. Toxicity assessment assumptions and default values.

Contaminant-specific variables are shown in the Appendix D tables, with their range of values, midpoint, the value used in the risk assessment and a brief rationale for their use and/or remarks about the confidence, or the uncertainties inherent in the variable.

**Table 3-6**  
**INPUT PARAMETER FOR GWSCREEN MODELING**

<b>REGULATED UNIT VARIABLES</b>			
<u>Variable Code</u>	<u>Description</u>	<u>Model Input</u>	<u>Source</u>
AL	Length of source parallel to ground water flow	Note (1)	Site specific characterization data
QI	Initial mass or activity in source volume	Note (2)	Based upon sampling data using the average concentration detected for that contaminant
THICKS	Thickness of source volume	Note (1)	Site specific characterization data
WA	Width of source perpendicular to ground water flow	Note (1)	Site specific characterization data
<b>PHYSICAL SITE PARAMETERS</b>			
<u>Variable Code</u>	<u>Description</u>	<u>Model Input</u>	<u>Source</u>
AX	Longitudinal Dispersivity	9 m	Track 2 Guidance Document (DOE-ID-10389)
AY	Transverse Dispersivity	4 m	Track 2 Guidance Document (DOE-ID-10389)
DEPTH	Distance between source volume to top of aquifer	16 m	Based upon interbed thickness only
PERC	Net water infiltration rate	0.1 m/y	Track 2 Guidance Document (DOE-ID-10389)
PHI	Effective porosity of the aquifer	0.1	Track 2 Guidance Document (DOE-ID-10389)
RHOA	Bulk density of aquifer material	1.9 g/cm <sup>3</sup>	Track 2 Guidance Document (DOE-ID-10389)
RHOS	Bulk density of source volume	1.5 g/cm <sup>3</sup>	Track 2 Guidance Document (DOE-ID-10389)
PHOU	Bulk density of unsaturated zone	1.9 g/cm <sup>3</sup>	Track 2 Guidance Document (DOE-ID-10389)
THETAS	Volumetric moisture content in contaminated zone	0.34 m/m	GWSCREEN Users Manual (EGG-GEO-10158)

**Table 3-6**  
**INPUT PARAMETER FOR GWSCREEN MODELING**

THETAU	Volumetric moisture content in unsaturated zone	0.34 m/m	GWSCREEN Users Manual (EGG-GEO-10158)
THICK	Well screen thickness	15m	Track 2 Guidance Document (DOE-ID-10389)
VX	Saturated pore velocity	1210 m/y	USGS publications from tracer studies
XD	Receptor distance parallel to ground water flow	Note (1)	Track 2 Guidance Document (DOE-ID-10389)
TD	Receptor distance perpendicular to ground water flow	OM	Track 2 Guidance Document (DOE-ID-10389)
<b>CONTAMINANT PARAMETERS</b>			
<u>Variable Code</u>	<u>Description</u>	<u>Model Input</u>	<u>Source</u>
SL	Solubility limit	Note (3)	Handbook of Chemistry and Physics (55th Edition)
THALF	Half life of contaminant	Note (3)	Nuclides and Isotopes, 14th edition
ZKDA	Sorption coefficient in the aquifer	Note (3)	Track 1 Guidance Document (Appendix F)
ZKDS	Sorption coefficient in the source volume	Note (3)	Track 1 Guidance Document (Appendix F)
ZKDU	Sorption coefficient in the unsaturated zone	Note (3)	Track 1 Guidance Document (Appendix F)
ZMW	Molecular weight of contaminant	Note (3)	Nuclides and Isotopes, 14th edition
<b>HEALTH ASSESSMENT VARIABLES</b>			
<u>Variable Code</u>	<u>Description</u>	<u>Model Input</u>	<u>Source</u>
AT	Time that exposure is averaged over	Carcinogen = 25,550 days Non-carcinogen = 10,950 days Ground water MCL = 365 days	Track 2 Guidance Document (DOE/ID-10389)



**Table 3-6  
INPUT PARAMETER FOR GMSCREEN MODELING**

BW	Body weight of standard man	70 kg	Track 2 Guidance Document (DOE/ID-10389)
DCF	Ingestion radiological dose conversion factor	Note (2)	DOE/EH-0071
DLIM	Radiological committed effective dose equivalent limit	0.004 rem/yr	GWScreen Users Manual (EGG-GEO-10158)
ED	Exposure Duration	Residential = 30 yrs Ground water MCL = 1 yr	Track 2 Guidance Document (DOE/ID-10389)
EF	Exposure Frequency	350 days/yr	Track 2 Guidance Document (DOE/ID-10389)
CRISK	Acceptable carcinogenic risk factor	1.0E-06	Track 2 Guidance Document (DOE/ID-10389)
HQ	Hazard Quotient	1	Track 2 Guidance Document (DOE/ID-10389)
I	Water intake rate	2 L/day	Track 2 Guidance Document (DOE/ID-10389)
RADMAX	Maximum allowable radionuclide concentration in ground water	Note (3)	Track 2 Guidance Document (DOE/ID-10389)
RFD	Reference dose for non-radiological contaminants	Note (3)	Health Effects Assessment Summary Tables
SFACTOR	Carcinogenic risk slope factor	Note (3)	Health Effects Assessment Summary Tables
ZRADMAX	Maximum allowable non-radiological contaminant ground water concentration	Note (3)	Calculated according to Track 2 Guidance Document (DOE/ID-10389) or an appropriate MCL
Note (1):	Site specific; refer to nature and extent description for actual value.		
Note (2):	Initial mass calculated based upon the average concentration detected during sampling and the estimated volume of the site.		
Note (3):	Contaminant specific value; refer to Table 3-1, Table 3-3, or Appendix D for actual value.		

Sources of uncertainty in the contaminant-specific values are 1) those inherent in the toxicity values, 2) those related to the physical parameter values used, 3) those identified from the data gaps, and 4) deficiencies in either the sample data due to the variability of soil samples or in the methods of analysis. The chronic reference doses (RfD and RfC) are defined in the HEAST THETA provisional estimates of the daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious non-carcinogenic effects during a lifetime. The RfD and RfC values are specific for the route of exposure as indicated in the tables. The uncertainty factors associated with these toxicity values, i.e., reference doses from IRIS and the HEAST document (EPA 1992b), reflect in some cases some of the uncertainty due to extrapolation of empirical animal data and large dosages to small doses to a human population and other types of discrepancies in the process of assigning numbers to be used. In assessing the carcinogenicity of a chemical, the chemical is classified according to the weight of evidence from epidemiologic and animal studies into one of the following five groups.

- |         |  |
|---------|--|
| Group A | Known human carcinogen (sufficient evidence of carcinogenicity in humans)  |
| Group B | Probable human carcinogen (B1 - limited evidence of carcinogenicity in humans; B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans) |
| Group C | Possible human carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data)  |
| Group D | Not classifiable as to human carcinogenicity (inadequate or no evidence)   |
| Group E | Evidence of noncarcinogenicity for humans (no evidence of carcinogenicity in adequate studies)   |

The cancer toxicity factors [slope factors (SF)] are characterized in the HEAST as the upper bound estimates that the true risks to humans, while not identifiable, are not likely to exceed the upper-bound estimates and in fact may be lower. Radionuclides are classified as Group A carcinogens, and as such have been assigned route specific slope factors (i.e., ingestion, inhalation and external exposure). Ingestion and inhalation slope factors are defined in the HEAST as best estimates (i.e., median or 50th percentile values) of the age-averaged, lifetime excess cancer incidence (fatal and nonfatal cancer) risk per unit of activity inhaled or ingested. External exposure slope factors are the best estimates of lifetime excess cancer incidence risk for each year of exposure.